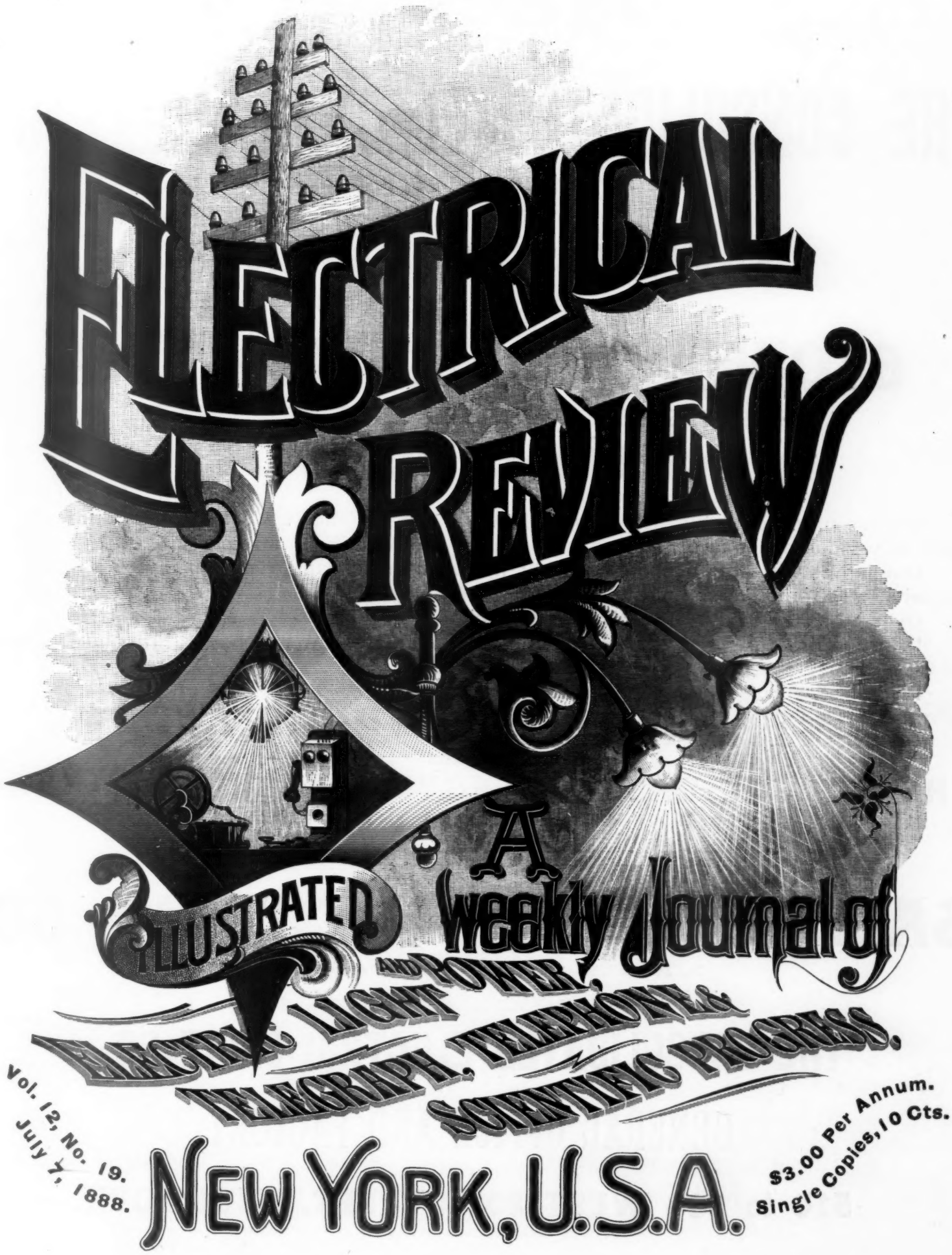

ELECTRICAL
REVIEW
ILLUSTRATED
A weekly Journal of
ELECTRIC LIGHT AND POWER,
TELEGRAPH, TELEPHONY &
SCIENTIFIC PROGRESS.
Vol. 12, No. 19.
July 7, 1888.
NEW YORK, U.S.A.
$3.00 Per Annum.
Single Copies, 10 Cts.

THE CONSOLIDATED ELECTRIC LIGHT CO.

GEORGE WESTINGHOUSE, Jr., President,

OWNERS OF THE

SAWYER-MAN PATENTS,

GENERAL OFFICE:

510 West 23d St., New York.

SPECIAL NOTICE.

New York, June, 1888.

We are prepared to furnish SAWYER-MAN INCANDESCENT LAMPS mounted in our bases of various styles and patterns, suitable for use on any commercial circuit.

Our lamps will not blacken and will maintain their candle power if not subjected to excessive electromotive force.

Over 400,000 Sawyer-Man Lamps in use.

In ordering lamps state the electromotive force (volts) at which your plant is run, and the type of socket you use.

Price Lists furnished on application.

SAWYER-MAN ELECTRIC COMPANY,

COMMERCIAL AGENTS FOR

THE CONSOLIDATED ELECTRIC LIGHT COMPANY,

510 WEST 23d STREET.

SAWYER-MAN ELECTRIC CO.

HENRY C. DAVIS, President,

COMMERCIAL AGENTS OF

THE CONSOLIDATED ELECTRIC LIGHT CO.,

GENERAL OFFICE AND FACTORY,

510 to 534 WEST 23d STREET, NEW YORK.

ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 12, No. 19. WEEKLY.

NEW YORK, SATURDAY, JULY 7, 1888.

$3 per annum. Single Copies, 10 Cents.

Copyright, 1887, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

A MONUMENT TO ELECTRICITY.

THE GREAT LABORATORY OF THOMAS A. EDISON.—FULL DESCRIPTION OF ITS MANY INTERESTING FEATURES.

Probably the finest and most complete scientific and mechanical laboratory in the world, is located at Llewellyn Park, Orange, N. J., as the private enterprise of Mr. Thomas A. Edison. The laboratory certainly has no equal in the world in the variety and extent of its equipment. Long ago, Mr. Edisor, who, like other inventors, has suffered from want of facilities, determined he would one day build and equip a laboratory which should be a storehouse of everything, and from which any possible want might be almost instantly satisfied. An inventor, as a rule, is nothing if not in a hurry, and it is aggravating to get to a certain point in experimenting, find an addition necessary, and then be told a week must elapse before the requirement can be filled and the experiment proceeded with. Every inventor has experienced the torments of anxious waiting in this way. But Mr. Edison is now forever done with such torments. He has not merely a laboratory of unequalled extent, but he has a storehouse of everything, a perfectly equipped machine shop, capable of turning out the heaviest as well as the most delicate kinds of work, with workmen of the highest skill in every department; a veritable central station, adapted to furnish any desired current for experiments; a chemical laboratory of the most complete description; a scientific library of enormous proportions; and in short, he has a modernized Aladdin's Lamp, by whose aid every wish almost can be at his bidding converted into an accomplished fact.

In order to give our readers an idea of this great institution, we present some views of the laboratory. Fig. 2 gives a general idea of the main building and power room. Back of the main building are four separate one-story brick structures, one of which is seen at the left, connected by an arch over the driveway, and is called the galvanometer house. Parallel with this, but separated from each other entirely, are the chemical laboratory, pattern room, and metallurgical building. In the main building, the front end is taken up by the superb library and reading room, part of the interior of which is shown in Fig. 1, above which is the lecture room. The remainder of the first floor of main building is occupied by the machine shop along the inside, and the wonderful storeroom along the front, and accessible directly from the street for delivery of goods and supplies. The machine shop is partly shown in Fig. 4, and is equipped with a full outfit of tools of the highest grade throughout. The heavier tools are on the first floor, and the corresponding portion of the second floor is taken up with smaller tools, such as are needed for work of small dimensions requiring precision in manufacture. It is here the recent phonograph experiments were carried on. The right hand side of the first floor is taken up by the storeroom, and of this it may be said there is not another such in the whole world.

It contains literally a little of everything in the line of natural and manufactured material known to modern commerce, and no want can occur which cannot be instantly satisfied.

Along the right hand side of the second floor of the main building are arranged in separate rooms the draughting, photographic, chemical experimental, physical experimental, and private experimental departments, as also the various private sections not open to the public gaze.

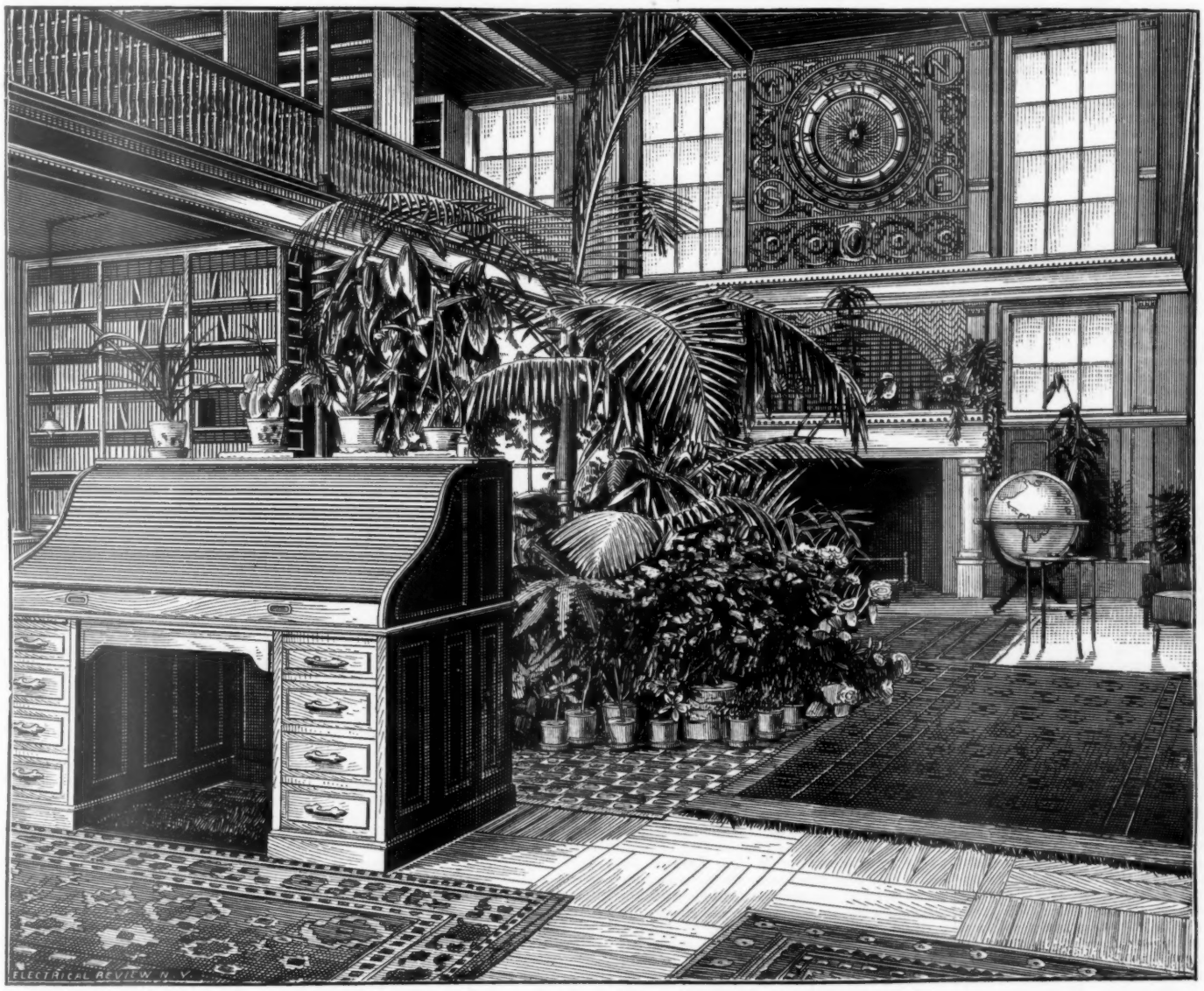


FIG. 1.—THE LABORATORY OF THOMAS A. EDISON.—VIEW IN THE LIBRARY.

The top floor is taken up by the lecture room, the lamp department and the cabinets of models, containing thousands of apparatus made in the past by Mr. Edison and by his associate, Mr. E. T. Gilliland. This latter is one of the most interesting parts of the whole plant, and illustrates in a most striking manner the extraordinary fertility of Edison's faculties for invention and design. The models are arranged in a sort of historical fashion, showing the evolution of a multitude of Edison's inventions from the earlier stages to the form finally adopted for commercial

use. This, like the store-room, probably has not its fellow in all the world. Experimental work is being constantly done in lamp improvement on this floor, notwithstanding the success met with by the new Edison lamp, which is now being supplied on a basis of 3.1 watts per candle at a life of 3,000 hours, giving 15 lamps of 16 candle power each per electrical horse-power.

The library is a magnificent affair. It is a spacious, high-ceiled room, with three tiers of alcoves and two balconies around the room, all finished elaborately in hard wood, and will hold about 100,000 volumes. It is not yet completely filled, but will soon be, at the rate of stocking now going on. Tables and writing desks are conveniently arranged, and any given subject can be quickly studied up in comfortable chairs, under a strong light and the pleasant surroundings of Turkish rugs and exotic plants. Electric lamps are everywhere, ready to be lighted at will, both here in the library and in every part of the buildings.

The lecture room is devoted to lectures by various members of Mr. Edison's staff, and these are given on regular occasions. A raised platform, with experimental tables and blackboards for illustrations, occupies the center of one of the sides, and at the wall are the terminals from the distant dynamos and batteries ready to supply current for all sorts of experiment or demonstration.

Fig. 4 shows the power and dynamo room, which stands at the far end of the main building. This contains two Armington & Sims automatic cut-off engines, each 150 horse-power, one being a spare engine in case of accident to the other. It drives all the shafting in the various departments, and a group of Edison dynamos of various types, the current of which is used in different departments, and for lighting the entire building when necessary. The two engines are shown in the background, being partly hidden by their band wheels and the dynamos. Babcock & Wilcox boilers are used in the steam plant.

The galvanometer building has a number of instrument pillars of solid masonry with capstones, all independent of the floor, and contains a splendid collection of testing and measuring apparatus. Among the more important may be mentioned the following: An astronomical clock, a chronograph, a spectrometer, Edelmann's "Fallapparat," Edmonson's calculating machine, Edison's magnetic bridge; the following Siemens' instruments: universal galvanometer, sine and tangent galvanometer, electro-dynamometer and ring tangent galvanometer; Hartman and Braun instruments: three dead beat reflecting galvanometers, two sensitive horizontal galvanometers, four voltmeters, a bi-filar variometer, a galvanoscope, and two telescopes; a Kohlrausch spring ammeter, a Carpentier galvanometer, a Cardew voltmeter, a Gauss magnetometer, and a portable by Edelmann, a Thomson quadrant electrometer, an Edelmann "cylinderquadranten" electrometer, a Lippman mercury electrometer, an Elliott Bros. mirror galvanometer, a Weber's "Erd-Inductor" (Inclinatometer), a Kohlrausch Wheatstone-Kirchhoff bridge (potentiometer), Kohlrausch universal rheometer, a complete cabinet photometer by Alex. Wright & Co., a Kohlrausch dynamometer, an Edelmann "absolute" galvanometer, and, in addition to these, a great multitude of minor instruments,

Altogether, the laboratory has not its equal in the world. Mr. Edison has personally selected his assistants and workmen, the requirement being the highest intelligence and skill; and it may be safely said that nowhere else can be found a corps of officers and workmen combining the intellectual knowledge and mechanical expertness here drawn together. Necessarily, under such auspices, and with such facilities, important inventions must be the outcome. Even now extensive experiments are going forward in the separation and extraction of metals from ores, as well as in a number of other lines, and we shall doubtless hear of them ere long.

The laboratory, the fulfilment of the unexpressed hopes of the genial inventor for years past, would seem to be one of his greatest achievements; but he himself considers as his greatest work the establishment and successful operation of the great central station in Pearl street, this city. The task was undertaken at a time when absolutely nothing had been done from which example could be taken. There were no finger posts, no beaten paths, nothing but a wilderness of darkness and obscurity. Everything had to be invented, the dynamos, regulators, indicators, distributing mains and feeders, house-wiring devices, meters, lamps, holders and a myriad of minor details. Yet these were all devised, put in practical form, applied, the great network switched in, brushes applied, steam raised, the engines started and thousands of lamps started into illuminated life, and, not the least extraordinary part of it, from that moment to the present, there has not been a single cessation of current in the mains. Truly it was a great work, and one which has become a conspicuous mile post on the wayside of electrical history.

THE AERIAL WIRE PROBLEM.

THE ELECTRIC CLUB LISTENS TO AN ABLE ADDRESS ON "OVERHEAD WIRES," BY PROF. WM. A. ANTHONY—ANIMATED DISCUSSION.

The Electric Club held its regular monthly meeting Thursday evening, June 28th, Vice-President O. E. Madden presiding in the absence of the president, in Europe. Among the gentlemen present during the evening were the following named: A. O. Tate, Captain Henry Erben, U. S. N., Lieut. F. W. Toppan, U. S. N., H. L. Storke, Prof. Wm. A. Anthony, Gen. O. E. Madden, S. S. Wheeler, W. M. Clarke, George Worthington, J. W. Godfrey, John Beesley, Willard L. Candee, Geo. B. Coggeshall, H. A. Sinclair, Nikola Tesla, Cyrus O. Baker, Jr., E. A. Colby, M. M. Garner, C. J. Hague, E. M. Hamilton, Chas. W. Spear, J. J. Carty, C. W. Price, Chas. Tucker, Oscar Hoftman, J. C. Chamberlain, W. H. Johnstone, Commissioner Dan'l L. Gibbons, Senator Ecclesine; Prof. Wm. Dennis Marks and A. J. De Camp, of Philadelphia; C. J. H. Woodbury, of Boston; Prof. F. Van Rysselberghe, of Brussels.

A number of the gentlemen discussed the club's excellent dinner, and at 8:30 Mr. Madden called the members to order in the assembly room, and introduced Prof. Anthony as the speaker of the evening:

"OVERHEAD WIRES"—BY PROF. WM. A. ANTHONY.

Mr. President and Gentlemen of the Electric Club:

When your president asked me to give you a little talk this evening, I thought at first I should not be able to do anything whatever, but finally concluded to occupy a few minutes time on the subject of "Overhead Wires," with the hope that it might elicit some discussion afterwards that would bring out something of value, and I hope you will look upon what I have to present as merely a subject for discussion in which you will take part later.

In 1843, Morse began his famous telegraph line from Washington to Baltimore to demonstrate the practical utility of what almost everyone at that time characterized as a most foolish visionary scheme. The proposal was to lay the wire underground, and what was supposed to be a well insulated lead-covered wire was planned for the purpose. Ezra Cornell was employed to lay it, and he invented a plow to use for the purpose. At first all went on well. Signals were sent and received and readily understood. But after a few miles had been laid the signals became feeble, and before a quarter of the distance had been covered they were no longer intelligible. This meant failure. Half the government appropriation had already been expended, and it seemed impossible to achieve success with the funds available. At this juncture Mr. Cornell proposed putting the wire on poles. This suggestion was finally adopted. The money sufficed to build the overhead line, and its completion brought the success that Morse through long years had been praying for.

This was the beginning of the overhead lines, that to judge from the newspaper reports, are working such dire results in New York City. The telegraph having proved its utility, became an established fact, and the first underground line having proved a disastrous failure, the promoters adhered to the overhead line that had achieved for the enterprize its first success. Telegraphs grew and multiplied. Scores and hundreds of lines came into New York City. In street after street appeared the huge poles carrying their many wires. Then came the telephone with the myriads of wires that it demands, and then the electric light added another element to the many-ply net work that covered the city. You were provided with the most complete system of communication with the whole outside world, you were enabled to converse with each other, though at opposite ends of the city, upon matters most weighty or the most trivial. Your streets were made to blaze with the light of day, and your offices and houses were provided with a soft mellow light that left the air untainted and but little warmed. All this the wires brought to you, and you have adopted it as a part of your daily life. With all their inconveniencies, their annoyances, their shortcomings, the telegraph, the telephone and the electric light are indispensable to your present civilization, and you would indignantly reject any proposition to go back to the condition of 40, 30, 20 or even ten years ago. No doubt you have paid dearly for these new facilities. You would pay far more before you would do without them. The overhead wires have disfigured your streets and covered your house tops, have been very much in the way in case of fire and have killed five of your citizens. You would be glad to have them removed if the service they render could be provided in some other way. But electric service cannot be rendered without conductors, and these must be carried somewhere, either overhead or underground. So the question came up, can we not go back to Morse's first plan and put the wires underground? Electricians began to consider the question long before the general public asked it, and when we began to consider it, it was soon seen that in all these years while the uses of electricity were multiplying with enormous rapidity, we had been content with the overhead wires and had made little progress toward the solution of the problem of underground conductors. The problem was seen to be a far more complicated one than when Ezra Cornell was ploughing a furrow into which to lay his insulated wire. Here were hundreds upon hundreds of telegraph wires, telephone wires by the thousand, and electric light wires by the score, all of which must be buried, and buried in such a way that they would each be entirely independent of the other, and each be able to perform its own function without interference or interruption. They must be so laid as to be readily accessible for repairs or extension of the service, and the cost must not be so excessive as to practically prohibit the acceptance of the service they were intended to render.

Inventors attacked the problem and numerous plans were proposed and patented, each of which in the estimate of its author completely overcame all difficulties. But disinterested electricians who knew the demands of the service and the difficulties to be encountered, knew that none of the plans proposed could come near answering all the requirements of the service, and I venture to say that if the wires were underground to-day in accordance with the best of our knowledge of the means of accomplishing the ends sought, we should be far from satisfied with the results obtained.

Difficulties encountered by the firemen a few years ago in consequence of wires in front of the burning building occasioned a hue and cry in the daily papers in regard to the overhead wire curse. All sorts of exaggerated accounts of the dangers due to the electric light current were published. One represented that if a stream of water from a fire engine struck the wires the current would follow the stream back to the nozzle and kill the firemen. Other equally absurd statements appeared and were swallowed by the public who knew but little of the laws that governed this comparatively new agent, and parties who had underground systems to sell found it easy to create a demand that the wires be put underground. The State legislatures caught up the cry and with the usual readiness of legislators to act upon matters about which they knew nothing whatever, an act was passed requiring that all the wires in New York City should be placed underground before November 1st, 1885. They might as well have decreed that on and after that date all the transatlantic travel should be by means of balloon, or that New York should have an honest city government. We were just as nearly ready for the one as for the other. No system had been devised by which so many wires could be put underground and continue to perform their function satisfactorily. Indeed I am inclined to think that no satisfactory system will be devised short of a system of tunnels underlying all the streets, and large enough to permit access to any and all wires in any place. What are the difficulties? Telegraph lines we know can now be successfully insulated and worked when laid underground or underwater, but such lines are by no means free from interruptions from faults, and the cost of repairs is, of course, great. When many lines are to be provided the temptation is to diminish the first cost by the use of multiple cables, but this brings greater danger and greater cost of repairs.

Telephone lines present still other difficulties. Induction comes in to transmit to the telephone the effects of all sorts of electrical disturbances in neighboring wires, or in the earth. Nothing will completely remedy this short of employing for each pair of instruments a complete metallic circuit, the two branches of which are twisted together or otherwise so placed as to have the same position relative to any outside disturbance. I think if telephone companies were to adopt such system of distribution, and charge enough to pay expenses and interest on capital invested, there would be a wail about telephone charges such as has never been heard yet.

Other difficulties still present themselves when electric light, especially arc light, wires are buried. With the high potential and large currents the difficulties of permanent insulation are enormously increased. If lightning strikes the wires it jumps through the insulation to the outside metallic covering, and in so doing establishes an arc that means destruction, not only to the insulation, but to the conductor. Now let it be proposed to put underground all the tens of thousands of wires in the city, telegraph, telephone and electric light, in close proximity as they must be, in many cases, and I think the problem would appear appalling to any one except a commissioner or newspaper reporter who knew nothing about it.

In a work just received on "Municipal Lighting," is a very good resume of the whole subject of underground conductors. The opinions of a large number of persons have been collected, and the results of a great many experiments are, for the first time, brought together where they are easy of access. Some of the discussions are good and others are good—for nothing. It is not to be wondered at that the general public does not understand the problem, when a president of an electric lighting company, in a paper before an electrical convention, gives the following as one of the difficulties in the way of putting arc wires underground:

"The question is frequently asked, if telephone and telegraph wires can be placed underground, why cannot arc wires be disposed of in the same way? The reason is plain; leakage or escape can be supplied in the former by an additional battery power, but an arc light generator is a queer specimen of mechanics. It starts a mild current, and this passing back around its field magnets, builds them up; the increased magnetism induces greater impulses in the bobbins of the armature; the current thus increased, continues to pass through the line and back around the field magnets, until the current has reached its maximum. It is therefore apparent that anything which saps the current from the line not only steals the quantity which has escaped, but prevents just so much current from passing back around the field magnets, and to that extent robs the machine of its capacity to generate a current. These machines are capable of taking care of the small amount of loss at the insulators in the pole and line system, but when this is multiplied many times, as in an underground conduit, they are so robbed of their power to recuperate, that the resulting lights are necessarily reduced in number, and are weak and sickly."

The present aspect of the whole problem may, however, be pretty well derived from the matter there published, and the general opinion is that no means of permanently insulating arc light wires has yet been found. Some say that the electrical difficulties are all overcome, only a few *mechanical* difficulties remain. I do not not know that any electrical difficulties have ever existed, all that is wanted is to overcome the mechanical difficulty of obtaining a perfect electrical insulation. Another says that the use of underground conductors is already a complete success, but a little further on it appears that the statement ought to read will be a complete success when we have discovered another thing or two. Another says he has had an underground conductor in use for three years, and therefore the problem is solved. Well, I myself laid down a conductor on the Cornell University campus in 1878 or 1879 that was used at first to convey the current for two Wallace plate carbon lamps and for the last five years has formed part of the circuit of a 20 arc light dynamo. It has been in use every dark night since it was laid, and its insulation is still up in the millions. Yet, I am not prepared to take the contract to put your arc wires underground here in New York City.

Why do we want the wires underground? The reasons assigned are, first, that they disfigure and obstruct the streets. They are not handsome and they are in the way. We would gladly be rid of them if we could have the service at a reasonable cost without them. Another reason is the danger from the arc light wires. How much danger is there? If you grasp the wires it is almost certain death. But if you fall to the sidewalk from the top of a fourteen story building or sit on the safety valve of a steam boiler and the boiler explodes, or if you and a locomotive try to travel the same track at the same time, the chances of doing these things without personal injury are rather remote.

The amount of danger in any case is very well measured by the number of casualties. How many have been injured in New York by the arc light wires? Five! Five in ten years! Half a man a year! Three of these occurred this Spring within a few weeks of each other and afforded a pretext for a fresh howl from the public press about the overhead wires. The deaths were chronicled under great head lines. The death dealing wires came in for a daily column. The mayor was called upon to account for his neglect to order the wires underground, and the public were led to believe that death was following everyone upon the street with a lasso of line wire attached to a 3,000 volt power dynamo. But instead of these cases indicating such great danger it was their very rarity that made them so noticeable. A death by an electric light wire was a new item of news, something to be served up in the finest style, and the reporters made much of it.

Since I promised your president to give you a talk upon this subject about three weeks ago, I have seen six cases of death or severe injuries by horse car. In every case the item was confined to a bare statement of the fact in the finest type and without the slightest attempt at display. Some twenty-five deaths and over a hundred and thirty severe injuries have occurred from vehicles in the streets of New York since January 1st and yet there is no talk of putting the vehicles underground, and only one paper has suggested the obvious remedy of burying some of the drivers. If deaths or injuries by electric light wires were as common in occurrence, these too would be

chronicled in the finest type on the least conspicuous place on the page.

In the last case of death from the electric wire the coroner thought he saw his opportunity to make his name immortal. He would make an exhaustive study of the whole subject of overhead and underground wires under the guise of a coroner's inquest. He summoned experts and laymen, officials and non-officials, and asked questions by the hundred. The inquest furnished column after column for the newspaper, and gave continued use for the great head lines on the overhead wires nuisance. One of the electric light officials admitted that there was danger attending the work of the linemen, and the coroner asked, "Do you continue to send your men on such work when you admit there is danger?" How that question opened my eyes! Why should any one incur danger in the pursuit of his occupation.

A few weeks ago a locomotive exploded *en route* to Hartford, just beyond our factory at Manchester. In company with others I went out to see the wreck. The fireman was killed, and the engineer fatally injured, and while I was standing there another engine came up with a car containing sleeping bunks, for the purpose of taking the injured engineer and the body of the fireman to Hartford. The wreck was a fearful sight; the water leg of the boiler torn to fragments, and the locomotive turned nearly upside down, and end for end. The newly arrived engineer and fireman stepped to the side of their cab to see the wreck, and I remember wondering what must be their thoughts. Why should not their engines explode at any moment, and their own bodies occupy the bunks in the ambulance car! Was there danger? Undoubtedly there was; but it never occurred to me that they should leave their posts, or that I should do so in their place.

I have wondered since how it could be that the officials of the road were not pressing into service every telegraph and messenger to order all the locomotives abandoned. But no, trains run as usual, and engineers and firemen, conductors and brakemen daily accept the danger that the public may travel. There is danger everywhere—in erecting our buildings, in running our elevators, in driving our coaches, in sailing our yachts, in mining our coal, in making our powder, and yet we ask men to perform these services for us and accept the service. We are criminally guilty if we by carelessness or neglect make the service more hazardous than it need be, but if we were to give up every service in which there was danger to life we should give up obtaining or preparing our food or providing for ourselves shelter.

No doubt there is danger in the electric light wires, but that danger to people generally in the city is extremely small. The danger in crossing the street is thousands of times as great. The danger on the railroad train, on the steamer, on the ferry-boat, in eating your lunch, or drinking your soda water, is far greater, yet you do these things without a care for the consequences. The other day I read of two or three persons being killed by fallen bricks blown from a chimney, but the papers said nothing about a proclamation by the Mayor ordering all chimneys taken in.

The danger from overhead wires is by far the least of all the reasons for removing them. Linemen would still have to make new connections, and I am not sure that their danger would not be increased rather than diminished by putting the wires underground.

In conclusion, by all means put the wires underground if you can afford to adopt any plan that will insure an efficient, satisfactory service. It will improve the appearance of your city, will remove one of the least of the obstructions in your streets, but will not in any appreciable degree lessen the dangers that surround you.

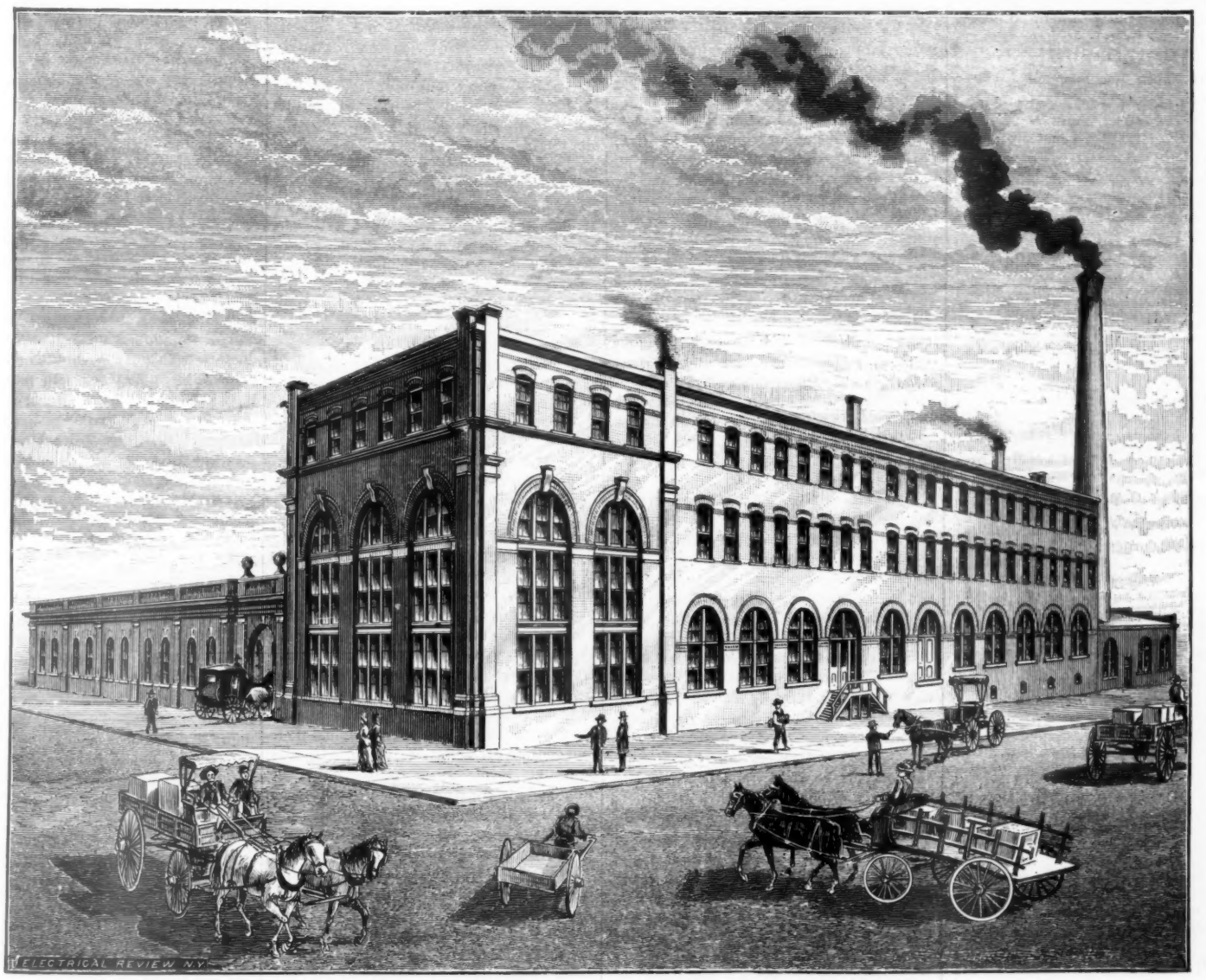


FIG. 2.—VIEW OF EXTERIOR OF THE LABORATORY OF THOMAS A. EDISON, LLEWELLYN PARK, ORANGE, N. J.—(SEE PAGES 6 AND 7.)

THE DISCUSSION.

Professor W. D. Marks: I came here rather to listen than to speak. The experiences I have had have been rather in the direction of underground wires, and I know there are a great many questions to meet. One thing seems to be overlooked altogether by the electric lighting interest. We understand that danger does not occur in electric lighting, save when the potential is high, how high we do not exactly know. I have heard of men taking 1,000 volts. I have myself, I think, taken somewhere in that neighborhood accidentally, and I saw a case in which 600 volts measured were taken by an old woman without injury to her beyond the mere shock. The real danger of electric lighting lies in high potentials. The danger in an underground system where a leak occurs, where one of the wires is grounded, we all know arises from the fact that a man who is making repairs is standing on the ground, and if he takes hold of the circuit at any point, the circuit will pass through him in all probability. I agree with Professor Anthony that perfect insulation has not yet been found, but I think we have been deterred in that direction more by the expenses than by the impossibility of the task. I think when the electric lighting business has grown into a regular business, with large capital invested, we will insulate more and more perfectly. I am a distinct believer in underground wires and their entire feasibility, whatever the potential may be.

Mr. C. J. H. Woodbury: Two years ago, in the course of a rather hastily written paper which I read before the electric light convention in Baltimore, I made the remark that a lineman was in infinitely more danger from gravity than from electricity. The question of underground wires varies from other underground apparatus in our cities—a perfection is necessary that is not necessary with gas pipes and water pipes and the very few steam pipes which are under our streets. Any imperfection or leak merely signifies the loss of so much of the material conducted, but in electrical underground wires, in addition to the electrical energy lost, it robs the apparatus of what is desired of it, be it telegraph, telephone, or electric light wires. These matters have all received very careful consideration, and the element of insulation under city streets is an exceedingly complex one when the question of insulation of currents of high potential is considered, apart from the other and even more complicated problems of induction. The question is very often brought up, "If you can carry currents of electricity upon submarine conductors, why not under the streets?" It should be remembered in this connection, that submarine conductors were tried for years and years, and until the discovery of gutta percha as an insulator of very high resistance which would withstand sea water, such submarine cables were not successful. In the conditions imposed upon submarine cables, we have simply those of high electrical resistance, and also resistance to water, but in the underground conductors in our city we have, in addition to that, the necessity for resisting the sewage percolating through the streets, and the escape of illuminating gas, especially where it is made after the water gas process in use in New York and many of our great cities, where it contains from the destructive distillation of naphtha, used for enriching the gas, hydro-carbons which are the strongest known solvents of the best insulators; and moreover, that the substances must with stand a great range of variations in temperature, being quite viscid in the heat of summer, and extremely brittle in winter; that it must withstand the impact of traffic, the stress induced by the settling of buildings, with all these we have a necessity for a very wide range of physical properties in the substance which shall be a perfect insulator. It does not appear to me that from the attempts to provide such an insulator, that successful results have been obtained. This condition of affairs is not by any means due to neglect on the part of the electrical companies, for it is well known the Western Union Telegraph Company has spent thousands of dollars in the city of New York in attempts to satisfactorily provide an underground system for their telegraph wires. The telephone companies here and elsewhere have spent nearly as much money in very exhaustive experiments, without reaching the results which they desire to introduce generally, on account of the knowledge that the service for such underground wires would be imperfect, unsatisfactory, and actually prohibitory in their expense. On the other hand, the difficulties with overhead wires have been exaggerated. There are difficulties, but that is true of everything pertaining to any of the occupations of life. There is always a danger in the transmission of energy in any form, whether it be in the noisy locomotive or in the still wires. The demand of the public on the electrical companies for the rapid spread or introduction of wires for telegraph or telephone, has been such as to render their distribution around cities a matter that has outgrown any system which could have been formed in the first place by the most wise human foresight, and it will take time for the arrangements which are still in progress in all cities, for reducing the overhead wires to what has been termed

(*Continued on Page* 8.)

ELECTRICAL REVIEW

Published at 13 Park Row

P. O. BOX 3329.

GEO. WORTHINGTON, - - Editor.
CHARLES W. PRICE, - Associate Editor.
T. J. McTIGHE, Electrician and Manager Patent Bureau.
LOREN N. DOWNS, - - President.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
TELEPHONE CALL, 546 JOHN.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.

Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N.Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E.D., N. Y.

EDITORIAL ANNOUNCEMENT

Address all communications and make all Express Money orders, P. O. orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

☞ No attention will be paid to communications without the *name and address of the writer.*

We invite correspondence from Electricians, Inventors, and the Telegragh and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Timothy W. Sprague, Massachusetts Institute of Technology, is our representative at Boston, Mass.

Mr. C. C. Haskins, 118 La Salle Street, Chicago, Ill., represents the REVIEW in the West.

NEW YORK, JULY 7, 1888.

CONTENTS.

	PAGE.
A Monument to Electricity	1
The Aerial Wire Problem	2, 3, 8
Telephones for the London Police	4
The Man Edison	4
The Silly Work of the Board of Electrical Control	4
Our Chicago Letter	4
Our Boston Letter	5
An Immense Sale of Incandescent Lamps	5
An Argument in Favor of Underground Wires	5
Electric Club Notes	5
Personal	5
Telegraphic	6
How the Convention News Was Sent	6
The Parrot and the Telephone	7
The Telephone Situation in St. Louis	7
Complimenting the REVIEW	7
The New England Electric Exchange Indorsed by the Insurance Interests	7
Telephonic News	7
New Thomson-Houston Dynamo	8
Electric Power	8
Hunting for Dead Wires	9
To Manufacture Aluminum and Silicon	9
A Point for Inventors who "Don't P'int Out"	9
The Influence of the Condenser on Disruptive Discharges	9, 10
Electric Light News	9
An Electric Bone Cutter	10
Manufacturing Notes	10
New Corporations	10
A New Motor	10
Electrical Patents	11

No matter who is made President, the electric motor is bound to run this country, or at least all its machinery.

It would be hard to say whose boom will be the greatest this fall—Harrison's, Cleveland's, or the electric motor's.

Even England is waking up to a realizing sense of the importance of appearing on the scene with a commercial line of motors.

The electric storms of the past few weeks have been unusually severe, and have attracted the attention of many scientists. As yet, the individual who can tell us how to control the electric storm has not proven his claims.

The London General Omnibus Company have had about 50 of their cars filled with electric light. The power is supplied by a small secondary battery placed under the seat. All the cars are to be lit in this way by next fall, should the experiment prove a success.

The underground question is pretty thoroughly discussed in this issue of the REVIEW. A number of excellent points were made in the discussion at the Electric Club, and we would call attention to these, as well as the remarks of Mr. Sunny and those of our Chicago correspondent.

The primary battery for electric lighting keeps bobbing up. If there wasn't always so much stock for sale in these companies, instead of the promoters proving their claims by commercial lighting, there might be some excuse for the public being gulled. As it is, the REVIEW hasn't much sympathy to waste on investors in this class of electrical stocks.

A cable dispatch last Sunday from London to the New York daily press says the new phonograph is being lionized over there. Another item in this respect is to the effect that a number of leading actresses in this city are using the phonograph to see how their voices sound to the public, believing that they never correctly hear all the tones of their voice while speaking.

In its comments on the paper on "Overhead Wires" read last week before the Electric Club by Prof. Wm. A. Anthony and the discussion which followed, the daily press of this city expressed great surprise that the electrical people did not think the danger from the wires would be lessened by their burial. The *Star*, in a column article, speaks of Professor Anthony's "new and somewhat startling argument that the burial of the wires would not diminish the danger to which the public is subject from them," and also quotes Mr. Tesla as saying that the burial of the wires would actually increase the danger. The *Sun* devotes considerable space to publishing the remarks of Mr. Woodbury, Prof. Anthony, Mr. Tesla, and others, and with surprised head-lines calls attention to the fact apparent to it that electricians favor putting the wires "higher up" instead of burying them, if the element of danger alone is to be considered. This was probably very new to the learned and unlearned New York editors, and we hope they will think it over. There are several very important problems connected with the burial of all the wires, and too much haste just now on the part of ignorant legislators may have a most ruinous effect on this industry. We commend Prof. Anthony's address and the discussion that followed to all our readers.

TELEPHONES FOR THE LONDON POLICE.

In view of the riots and unruly meetings of the unemployed which now take place every winter in the West End of London, the police authorities have found it necessary to provide efficient means of communication between the different stations, which are now connected together by a complete and independent system of telephones. There are also direct lines between some of the chief police offices, and the Fire Brigade stations, the Houses of Parliament, and the War Office. The arrangements are said to be so perfect, that it will be possible to collect a large force at any desired point, within a very short time.

THE MAN EDISON.

It seems fitting for the ELECTRICAL REVIEW, which devotes several of its columns to a description of Mr. Edison's laboratory, to say a few words about the man Edison. Personally, a most lovable gentleman whose magnificent triumph in winning fame, fortune and happiness, has not in the least changed his kindly disposition, nor has the coming of that satisfactory condition in his affairs which would permit him to take his ease, affected his energetic and very alert nature; and to-day he is as industrious as when a poor boy working the telegraph key the long night through and contending with fellow operators for the privilege of sleeping on a lounge in a Boston telegraph office.

Only last week every hour of two days and the intervening night were devoted, without rest, in completing an experiment in his laboratory.

There has grown out of the many interesting features in Edison's character, a number of fanciful accounts of the man and his methods. It is not our purpose to add to this line of newspaper work; but that he stands conspicuous to-day a most versatile and original inventor, that his life has been most fruitful and most valuable, enriching and embellishing history's ever-changing page, his critics and rivals will all admit. Enumeration of his works would be but calling attention to many of the most valuable and instructive elements of the past dozen years, which now enter into our daily life so thoroughly as to become recognized necessities.

May your good health, your genial wit and your ever-progressive and inventive mind continue with us, Mr. Edison, for many, many years. The REVIEW sincerely congratulates you on the successful completion of your magnificent laboratory.

THE SILLY WORK OF THE BOARD OF ELECTRICAL CONTROL.

The butchers, politicians and theatrical managers composing the New York Board of Electrical Control have decided to commence an attack upon the business of the electric lighting companies, and issued their first order Monday of this week to prevent the United States Illuminating Company from conducting its legitimate business of lighting along Sixth avenue, with the design of paralyzing its business in that section by the destruction of its wires now in use there and causing the arrest of its employés now operating them. It seems to us that the Board of Electrical Control will discover that there is quite enough law left to prevent the acts of vandalism contemplated by them upon the persons and property of this company. This Board of Electrical Control, so-called, has been the laughing stock of the public since it was created, but no person could have imagined that they possessed so little judgment as to invade the rights and attempt to destroy the property and business of our lighting companies. It is to be hoped that they will at once discover that such acts of destruction to these large business interests will not be permitted, and that some one will be held responsible for all the damages done the vast industrial interests by any lawless acts or endeavors of these misinformed and apparently malicious persons who thus invade and destroy one of the most important commercial enterprises of the day, under cover of recent statutes creating this Commission. The statutes were not enacted for any such purpose.

If we mistake not, the Board of Electrical Control may not be as handsome in a few days, but it will know more.

OUR CHICAGO LETTER.

(Special Correspondence.)

The convention, which closed last week, was one which required an immense amount of talk, outside as well as within the walls. The general public has little conception of the amount of telegraphic work necessary on such an occasion.

The Western Union Company was compelled to put on an extra force of about 100 men, and a perfect army of messengers. There were wires direct to 30 of the principal cities from the convention hall, independent of the main office, and there was almost no end of correspondence which the convention operators could not handle, and this was "rushed" to the main office by fleet footed messengers and animals under the saddle. There were 6 wires to Boston and 33 to New York, all direct. California, too, which was the butt end of the Blaine boom, received an average of 75,000 words a day, and New York received at the rate of 48,000 words per hour, during part of the time. Add to this an increase of over 10,000 messages a day during the convention, and we have some idea of the work. "And, yet," said Chief Lloyd, "we got through the whole thing without a kick from any newspaper or press association."

A good deal has been said of late relative to the danger from dead wires. These abominable relics of departed glory are constantly getting in the way, and are only good for mischief. "The iniquity of the thing," as good father Smith used to say, is in the fact that all these old, dead nuisances are wires that are not worth taking away for old junk. In this lies an argument in favor of better wiring. How would it work to compel the use of a conductor that it would pay to gather up and use again after the plant was abandoned or when it was moved. I saw a bundle half as large as my leg of number 16 B. & S. copper, forty or fifty feet long, gathered up the other day by a party who wanted just such a lot of paraffined wire that had no other owner. The former proprietor had had some misunderstanding with the legal authorities, and left that combination of conductors behind. The wires would have remained still other years, but for an electric light plant that came on ground and objected to associating with that form of wires.

And, again, there are perhaps miles of dead electric light wires lying around loose, that the users claim it doesn't pay to gather up for old copper. They say its a case similar to that of a four dollar a day carpenter stopping to pick up a nail.

So these mummies of the days that are gone are constantly increasing; now large, now small, paraffined, kerite, okonite, undertakers, and all, telephone, telegraph, ticker, or light wires—piling up everywhere, ready to cross the path of the electrical fiend, and give somebody—some innocent party a benefit. And now, after all is said, in the name of Tweed, "What are we going to do about it?"

The arc light and power people here take issue with Prof. Morton on the subject of underground possibilities for electric light currents.

Chicago, first in that field, has had more experience, and done more, than any other city in the world, in the way of advancing this matter. But Chicago is out in the West, the rowdy West, and doesn't hesitate because Europe, and especially England, says that the underground scheme is a failure. The fact is, that comparatively isolated, independent as a wood sawyer, Chicago has a habit of paddling its own canoe—accepting or rejecting what it pleases, and basing its selection on its own judgment. The world said there was no such thing as an underground conduit, but we have one here—nay, no less than seven kinds in a single street, and while some are not so good as others, all are in daily use—and they are all Chicago conduits. The electrical world asked for cables—and Chicago is making miles of cable every week. There are other cables, good cables, but Chicago cables stand in the front rank.

And if England, or France, or Russia wants to know more about underground conduits or cables, why Chicago, perhaps, would be a good place to come for information.

The old admonition, "look well to your ballots," is going to be repeated many times between now and November. In the meantime the printers had better be admonished to look well to their wood cuts. This putting Friend Smith of K. C. in papers and calling it Ben Harrison will make trouble if it isn't stopped.

CHICAGO, June 30, 1888. C. C. H.

OUR BOSTON LETTER.

(Special Correspondence.)

During the severe electric storm with which New England was favored on the evening of July 23d, Mr. A. H. Binden, of Wakefield, Mass., succeeded in duplicating his success of last summer, which created much astonishment at that time, of capturing a very clear and beautiful photograph of a lightning flash. This time he obtained two photographs, in one of which there are four very bright and distinct bolts, two of these crossing each other and having numerous branches which dart out from the main flash, giving the appearance of rivers of electricity with all their tributaries rushing from the clouds to the earth. The picture is taken with a lake in the foreground, whose dark waters and surrounding trees, illuminated by the lightning, together with the fine effects of the dark clouds above, make an intensely picturesque scene and a valuable addition to one's photographic collections.

The new electric railroad at Revere Beach, which was mentioned in my last letter, will be running about the middle of next week and will be a great accomodation to the many cottagers along Ocean avenue making social intercourse among them much more feasible than formerly.

The work upon the large electric light station of the North Shore Electric Company at Beachmont, has been continued both night and day during the past two weeks so that now everything is completed and the company expects to furnish current from the new station this evening, for the incancescent lights which have been placed in the hotels along the beach.

An electric light has been set up in front of the Strathmore House at Crescent Beach, about thirty feet from the shore, to afford the guests the pleasure of sea bathing by electric light in the evening.

The Fitchburg Railroad is introducing a system of electric lighting in the Hoosac Tunnel requiring 1,200 large incandescent lights. Sixty miles of wire will be used in the cables and about 100,000 feet of lumber will be used for enclosing and laying the same.

Mr. F. M. Sanderson, the electrician of the Walpole Gas and Electric Light Company, while engaged on the afternoon of June 27th in laying wires for the electric lights in the new passenger station of the Fitchburg Railroad in Waltham, was severely burned about the face and upper part of the head by the explosion of a naptha lamp that he was using, and will not be well, probably, for several weeks.

Mr. Joseph O. Procter, of Gloucester, has petitioned the mayor and aldermen of that city to be allowed to erect a-steam and electric light plant on Pine street. There has been much opposition brought forward against the granting of the petition, and the question is now under consideration.

Among the distinguished passengers who sailed for Europe yesterday in the "Cephalonia" was Professor Chas. R. Cross, of Technology. The professor was accompanied by his wife and also by his son, Chas. R. Cross, Jr.

The Sprague Electric Railway and Motor Company, during the past week, installed a ½ horse power motor at Dr. Osgood's office, 25 Tremont street. The motor will be used to run a furnace blower. The Atlantic and Pacific Tea Company have also been furnished with a 1 horse-power Sprague motor for running a coffee mill and printing press.

A new Telegraph line known as the Commercial, is to be extended from Portsmouth, N. H., through Biddeford and Saco as far east as Portland, Maine.

The fire alarm system at Marblehead, Mass., is to be extended, and an appropriation of $2,500 has been made for the purpose. Commonwealth avenue, Boston, from Arlington street to West Chester Park, is to be lighted by electric lights hung in the center of the roadway. L. A. F.

Boston, July 1, 1888.

An Immense sale of Incandescent Lamps.

The Consolidated Electric Light Company have just consummated a sale of six hundred thousand Sawyer-Man 16 candle power incandescent electric lamps, with an aggregate value of nearly $500,000. This is undoubtly the largest single operation ever made by an electrical company in the world.

An Argument in Favor of Underground Wires.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of June 23d, under the head of "Those Damp Conduits," you publish an interview with Prof. Henry Morton of Stevens Institute wherein he gives certain reasons why underground wires for arc circuits cannot be successfully operated.

There is no subject upon which a man can feel more at liberty to express his views without risking contradiction than this one of underground wires, and in this case we would feel inclined to believe what the professor says without questioning the accuracy were it not for the wide discrepancy that exists between what *he* says is true, and what we have *found* to be true.

He says a moist conduit is utterly worthless for carrying arc and, in some instances, incandescent currents, because there is no known insulation that will stand the effects of the moisture on the one hand and the tendency of the current to break through to the earth on the other. Further on, he says that no satisfactory material has been found for the protection of insulation on underground wires. This is a severe arraignment of the several manufacturers of underground cables for arc currents, and, no doubt, those gentlemen can convince the professor that his statement is a trifle broad and considerably lacking in accuracy.

We are working through 50 miles or more of lead cable in Chicago, all underground, and in a wet conduit, and are furnishing a satisfactory light service for 1,000 lamps. The lead cables contain an insulation six thirty-seconds of an inch thick, and while the cables of this type have only been in service about four months we have, so far, not had one case of trouble in them. It is true that the lead cables put in in November and December last were burned out almost immediately upon being put into service, but this was not because the insulation was not suitably protected from the moisture of the conduit, but was entirely owing to the fact that the insulation of three thirty-seconds of an inch was too thin. These cables had not been in service long enough to be impaired in the slightest by either gas or moisture, nor have the cables in use at present. It will, no doubt, take a long time to determine what the effect will be of the moisture and gas on the lead protection to the insulation, but we see no reason why there should be any, because of the fact that lead covered telegraph and telephone cables have been lying in the same conduits for four years and are in a good state of preservation.

The professor says in support of his position that in Philadelphia, a mile or two of arc light wire was put underground, but soon had to be abandoned. As he fails to furnish any particulars, it may be that he alludes to the circuit that we were told about at the Pittsburgh convention, which was not constructed according to the best ideas of underground work, and for the failure of which there were good reasons.

D. R. Walker, Chief of the Electrical Department of Philadelphia, says under date February, 1887, that "the Brush Company have been using underground cables on a 60-light circuit since the Fall of 1885, the current passing through the cable 22 hours a day, and that the daily test sheets show no deterioration." Evidently Professor Morton and Chief Walker are not in close communication on this subject, or else the latter has had some reverses in his underground experiences. Nor does the professor remember that Mr. Wilbur, of Girard College, has had an underground circuit of two miles, carrying 47 lights, in operation for a year without any trouble.

To the statement made by the professor that it is only possible to run electric light wires underground for a short distance (this term may be taken to mean 1,000 feet), I would say that some of the Chicago circuits contain between three and four miles of wire, and there is practically no difference in the service furnished on the long and short circuits.

The professor says that arc light wires would last for some time underground if provided with about *nine inches* of lead around the insulation. The lead around the Chicago cables is $\frac{1}{8}$ of an inch thick, and the diameter of the entire cable about $\frac{3}{4}$ of an inch.

Regarding the cause of the destruction of the lead cables that were used here in the early part of this year, we have no explanation that we can put forth with any degree of certainty. Many theories have been advanced, and among them are two that are worthy of consideration. The first is that when the dynamic current of 2,300 volts passes through the copper conductor, it generates static electricity in the lead covering around the insulation. Under ordinary circumstances the conduit, which is made of Dorsett material, is a good insulator, so that the lead is not connected with the earth. When the lead becomes fully charged the theory is that it discharges back into the copper conductor, puncturing the insulation at the point where the discharge occurs. Now a burn-out need not occur at the time of the puncturing, because the lead has no connection with the earth, and if the circuit is, aside from the puncture, in good shape, there is nothing to provoke a burn-out. When however the conditions in the conduit change so that the lead becomes grounded by moisture in the ducts or in the water in the man-holes, a burn-out takes place at the point where the insulation was punctured.

The second theory is that the belts on the dynamo generate a great quantity of static electricity, which finding no outlet to the earth in the dynamo room is carried into the dynamos and out upon the circuits where at some point in the lead cable it punctures the insulation and escapes to earth. Every one familiar with the jumping propensities of static electricity will understand how this theory can be applied to to the occurrences cited.

As has been stated, the "burn-outs" have all occurred in the cables of thin insulation ($\frac{3}{32}$ of an inch) while none have taken place in the larger ones ($\frac{6}{32}$). Accepting either one of the theories as correct, the exemption from trouble in the cables now in use can be credited to the thick insulation entirely.

While we do not take the position that we have solved the problem of working arc wires successfully underground, we do assume the position that it can be done, and that leaving out all of the instances of failure that were caused by construction that was palpably bad, there is more proof that it can be done than there is that it cannot be done.

It cannot be denied that the proper place for a large number of arc light wires is underground, and that there is justice and reason in the complaints of the New York press against the condition of affairs in that great city. The numberless poles and labyrinth of wires in the narrow and crowded streets, coupled with the semi-occasional report of some one severely injured if not killed, make in themselves a commentary on the electrical genius of the chief city in the country that ought to be humiliating for any man or set of men to bear.

The permanency and popularity of the service demand that it be carried on without imperilling the safety or convenience of any one, and the attitude that seems to have been assumed in New York that no change can be made on present methods is not calculated to help the service in either respect.

We are sorry for the encouragement that Prof. Morton gives to the anti-underground wire men for the reason that the data to be had does not justify him in doing so, and because, though it be accurate or inaccurate, such a statement from such a source may help to put off the day when improvements ought to be made that are imperative, not only for the general good but for the good of the arc light service. B. E. SUNNY.

CHICAGO, June 29, 1888.

The Sprague Electric Railway and Motor Company, New York, has received an order from the United States Government for motors for use in the service, and an installation is to be made at once on board the United States steel cruser "Chicago" of motors to be used in the training and elevation of the guns.

Electric Club Notes.

Messrs. F. W. Harrington, P. H. Alexander, H. B. Cram and J. T. Moriarty were Boston guests at the Club the first of the week, and were made comfortable and happy in its pleasant rooms.

At the conclusion of the last meeting, Prof. Anthony was given a unanimous vote of thanks for his interesting and valuable paper. We publish the address in full, and the discussion that followed.

Mr. E. R. Weeks, of Kansas City, Mo., vice-president of the National Electric Light Association, spent Monday and Tuesday at the club house. Electric lighting in the West he reports as still quite active.

Vice-President Madden assumed the honors of presiding officer with his usual grace, and under his discreet control the time devoted to discussions was most entertainingly and instructively occupied.

Prof. F. Van Rysselberghe, the widely known inventor, has arrived in New York from Brussels, and was a visitor at the Electric Club, Thursday night, the guest of Mr. W. H. Johnstone. The distinguished gentleman received a cordial welcome from the members of the club.

In addition to its gift to the Club of two fan motors, the C. and C. Motor Company very kindly loaned the Electric Club a half dozen extra motors, which were used in the parlors and dining and assembly rooms the night of the lecture, and proved an admirable means of keeping the the air cool and in circulation. A vote of thanks was tendered to the Motor Company by the Board of Managers.

A valuable painting was presented the club last week by Mr. C. J. H. Woodbury, of Boston, who in his letter spoke highly of the good work and influence of the club. The subject of the picture represents a scene at Grez near Fontainbleau, painted by Daniel Strain, a Boston artist of more than local reputation. The committee hung this elegant work in a conspicuous place in the front parlor of the club house.

Personal.

Mr. N. D. Nicholson, manager of the Syracuse Telephone Exchange, died last Friday, June 29th. He was a brother of General Manager C. A. Nicholson, of the N. Y. Central Telephone Company.

Mr. Chas. Dutton, of the Southern Bell Telephone Company, returned last Monday from a southern tour in which he investigated telephone matters to his heart's content. He is enthusiastic over the improvements now being made in the South.

Mr. W. M. Callender, the well-known cable manufacturer, returned the first of the week from a London visit of several weeks.

Col. M. W. Goodyear has returned from Martha's Vineyard, where he has been for two weeks superintending the laying of a Government cable. While putting down the cable this intrepid diver was attacked by a whale, which he promptly killed and cut up, and brought portions of the marine monster's anatomy with him to New York, to prove his statement.

—— The Electric Light Company at Trinidad, Col., have met with such pronounced success that they have found it necessary to increase their capacity, and to this end have ordered another engine from the Ball Engine Company of Erie, Pa.

—— The Paterson Electric Light Company of Paterson, N. J., have their building nearly completed. The system to be used is that of the Thomson-Houston Company of Boston, Mass., and the station will be one of the finest equipped in the United States. The steam plant consists of five 125 horse-power boilers and five 100 horse-power engines, which will be erected, complete in every detail, by the Ball Engine Company of Erie, Pa.

The REVIEW desires to acknowledge the very valuable assistance rendered it by the Photo-Electrotype Engraving Company, of this city, in the preparation of the fine illustrations of the laboratory of Thos. A. Edison. The work speaks for itself, and is a triumph of the photo-electrotyping art.

TELEGRAPHIC

.... At Montreal, June 23d, fire in the operating room of the Canadian Pacific Telegraph Company's main office there at five o'clock in the morning, caused a damage of nearly $20,000. The telegraph business was entirely suspended from that end of the line.

.... The American Telegraph Company elected Directors E. D. Adams, Michael P. Grace, William G. Hamilton, J. Pierpont Morgan, Charles Damer, Alfred Pell, Theodore J. de Sabla, James Scrymser, and Joseph E. Muanoz. A quarterly dividend of 1½ per cent. was declared.

.... The stockholders of the Mexican Telegraph Company have re-elected Directors John E. Alexander, John E. Blagden, James K. Gracie, William S. Hamilton, Edmund L. Bayliss, Robert D. Mintrim, J. Pierpont Morgan, Alfred Pell, and James A. Seymour. A quarterly dividend has been declared of 2½ per cent.

.... A despatch from Indianapolis, June 20th, says: "The Third Annual convention of the Order of Railway Telegraphers was formerly opened here to-day. Two hundred and fifty delegates from all parts of the United States and Canada are present, among whom are quite a number of ladies. An imposing parade took place to-day, headed by the best band in the State. Governor Gray being ill, an elegant address of welcome was made by Rev. O. C. McCulloch, of this city, and Grand Chief Thurston responded by a grand outlining of the objects of the order. Tomlinson Hall was crowded at the public meeting. The regular business of the convention begins to-morrow. Minnesota is better represented than any other State in the Union, having fifteen delegates. The delegates have been highly entertained by the Indianapolis division, and indications are that the convention will be a successful one."

How the Convention News Was Sent.

There have been between 250 and 300 special correspondents in the city, representing the daily press of the country, and as large a number of newspaper men who had no place at the working tables in the convention hall but were interested spectators from the galleries. All of these men have been writing columns of matter, speculating upon the outcome of the convention. To meet the demand the telegraph companies provided extra wires and a large corps of efficient operators, and it can safely be said that never before has there been a convention or any other event which sent out so much news as has gone from Chicago to the country and the world during the last ten days.

Superintendent Clowry, of the Western Union, says there never has been so large a telegraphic service anywhere as that of their company in the last week. The special matter from special correspondents alone amounted to 500,000 words a day from the time the convention assembled, a week ago this morning until last night.

The Western Associated Press sent out the regular report of the convention over leased wires, and telegraphed more than 20,000 words a day. The other press associations together sent out about the same amount of matter. In all, the wires of the Western Union Company have carried about 600,000 words a day, and reports and speculations on the convention in the last ten days which have been sent out from the Chicago office amount to about 6,000,000 words, or more than double the amount sent out from the St. Louis convention.

Superintendent Clowry says that the telegraph companies never had the same facilities for reporting a convention to the country before or anywhere else. The ante-room of the convention hall were thirty direct circuits to thirty of the leading cities and towns of the country, and these were manned by forty competent operators. All matter for afternoon papers, all bulletins, and all important telegrams filed were sent direct from the convention hall. Superintendent Clowry had a table directly in front of the speaker's stand, and George Bain sat there with him making up bulletins. He had two assistants to change the manifold for him and help him with the figures on the ballots. Connecting that table with the operating room below was a pneumatic tube, which carried all bulletins and all associated press matter to the operators.

Bulletins were sent by the Western Union to every city and town along their lines free of charge during the sessions of the convention, so that the whole country was informed as to what took place. Six mounted messengers carried matter for morning papers from the convention hall to the main office at the corner of Washington and LaSalle streets, where 350 operators manned the wires, and kept them humming day and night. With the relays, between 600 and 700 men were employed by the Western Union Company to take care of the convention reports. Arrangements were also made throughout the country for close attention to the working of the wires. Special locomotives and handcars were in readiness at all times to repair breaks which might occur and interfere with the service. But the weather was favorable, and the service has been unsurpassed. No city can compare with Chicago for telegraphic facilities for reporting great conventions. The city is the greatest distributing point in the country, and, located as it is, can reach all parts of the country by direct circuit without repeating matter, as it would have to be if sent from New York. From Chicago we can reach New York and San Francisco, St. Paul and New Orleans by direct wire, without repeating messages anywhere.

When the convention was taking the last ballot for President yesterday morning, lightning operators sat at their instruments below, with their fingers on the key, ready to flash the nomination over the whole country and the world. Mr. Bain and his assistants in front of the Speaker's desk kept tab on the vote, and the instant enough votes were recorded for Senator Harrison to give him the nomination the signal was given, and away it went to the outside world before the convention realized what it had done. The nomination was read from the Speaker's desk in the House at Washington before the Indiana delegation began to shout in the convention, and in thirty seconds from the time he had enough votes his nomination was read in San Francisco. It was cabled to London and read in the metropolis of the world two minutes after, and before the vote was announced in the convention.

Superintendent Clowry says that he has heard it said that there was but one operator in the wigwam in 1860 when Lincoln was nominated. In 1868, when General Grant was nominated in Crosby's Opera House, the Western Union officers and operators had the use of a proscenium box, and four operators sent out the report of that convention from the hall. In 1872, at Cincinnati, there was a greater interest taken in reaching the country by full telegraphic reports, and fifteen operators were in the hall.

Since then there have been special arrangements made, whereby the correspondents might file their matter in the convention hall. But there have been fully a million more words sent out from this convention than any other ever held. Superintendent Clowry has given his whole time to the convention, and has never been absent from his table in the hall during the session. Mr. C. H. Sommers had charge of the editorial circuits, and was assisted by W. B. Somerville, of New York, and Superintendent Tubbs, of the Chicago office.

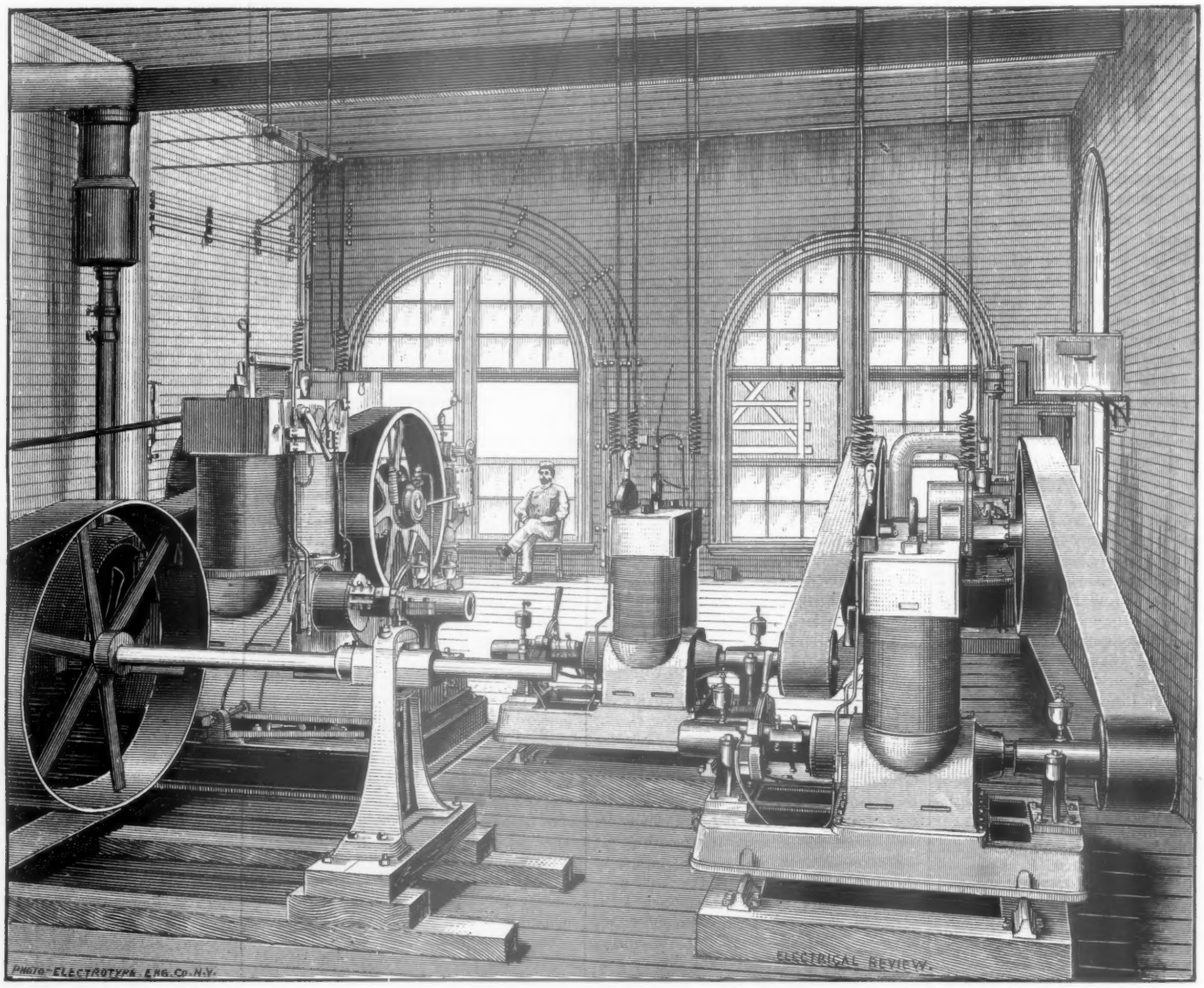


FIG. 3.—THE LABORATORY OF THOMAS A. EDISON.—DYNAMO ROOM.

Chief operator Lloyd at the main office, and Halligan at the convention hall, deserve the highest praise for their work. The newspaper men in the city spoke in the highest terms of praise of the way in which their reports were sent out, and the Associated Press also says the facilities were unequalled.

Let the newspapers vote, and Chicago will be made the permanent convention city, for in no other city are grouped the principal hotels so near together that delegates may be kept track of without running all over the city; in no other city is there such an admirable convention hall, and nowhere else can be found such telegraphic facilities. Then add to this the lake breezes, which can only efface the memories of the blistering and smothering heat the boys experienced at St. Louis three weeks ago. Let the newspaper correspondents vote, and all national conventions will be held in Chicago.—*Chicago Inter-Ocean.*

Col. George E. Gourand, of England, sailed for London last week, taking with him a new model of the Edison phonograph on which is recorded a message by the inventor. The Colonel will represent the phonograph company abroad.

The Parrot and the Telephone.

The pleasant Brooklyn home of General Manager W. D. Sargent, of widely-known telephone fame, is made particularly interesting on unexpected occasions by the speech of an accomplished parrot. The parrot came to the Sargent mansion from the home of another famous telephonist, Thomas Byron Doolittle, and it is supposed that while in the possession of its former owner it acquired a knowledge of telephone parlance that, with true parrot ingenuity, it quietly stored away it its green-tinted cranium, until it was finally provoked into given the language full vent, after hearing its new master use the telephone.

As the sun rises in the morning the following one-sided conversation can be heard, in deep, sepulchral tones, coming from a large cage near a rear window of Mr. Sargent's back parlor:

"Hello!"

.....

"*Hello!* HELLO!! HELLO!!.

.....

"Yes—this is Mr. Sargent."

.....

"Telephone don't work?"

....

"Spell it."

.....

"Oh! the diaphragm is loose. I'll send a man right down. Good-bye."

Then a brief silence and the parrot twists his ear, in the evident attempt to ring a telephone bell, and then starts afresh as follows:

"Is that you, Billy?"

.....

"That telephone of Mr. Smith's is still out of order. Why in *thunder* don't you fix it?"

.....

"Oh you did!"

....

"Fix it again."

....

And so on, until the parrot hears its master coming with a club, when it promptly begins to sing "Sweet Bell Mahone," knowing this to be the General Manager's favorite, and thus its life has been spared.

But some of these days, when the house is filled with company, that parrot will give away some of the secrets of the telephone conversations, and then its sweetest song will not save it from capital punishment.

The Telephone Situation in St. Louis.

Mr. George F. Durant, general manager of the Bell Telephone Company of St. Louis, was interviewed a few days ago relative to the replacement of the telephones which had been removed. He said: "It is very unfortunate that the Supreme Court has disallowed us a hearing in this matter now, but, instead, has deferred the case until the first day of the October term, as it was the wish of the company to have the trouble fully decided at once. But, as it is, we will adhere strictly to our agreement, and furnish the telephone service as before. About sixty have already been replaced, and the applications for more will be promptly attended to. We suffered quite a loss in the damage done to wires by the storm last week, but everything will be in shape soon." Mr. Durant seems to feel confident that the trouble will be settled with satisfaction to both parties.

Complimenting the "Review."

A large manufacturer of electrical goods, who had not previously been a regular patron of the advertising columns of this journal, placed a card in the REVIEW about a year ago. June 26th, 1888, he writes us as follows:

"I desire to have my advertisement continued in the ELECTRICAL REVIEW every week. I am pleased to inform you that since its publication in your widely read journal, my orders have been largely increased, and a new line of first-class trade has been opened up to me, notwithstanding the general depression of business.

"I also beg to say that most of those who have favored me with their orders take occasion to name your paper as the source of information regarding our specialties in the electric line."

The New England Electric Exchange Indorsed by the Insurance Interests.

Under the date of June 11, 1888, the following notice has been issued from Boston by the New England Insurance Exchange:

With a desire to add its influence to any measure or work having for its purpose the elevation of the standard of electric lighting, and believing that the work of licensing employés of electric lighting and power companies, recently undertaken by the New England Electric Exchange, will result in good to all, the New England Insurance Exchange has agreed to co-operate with the "Electric Exchange," and will, on and after October 1, 1888, require that all persons engaged in installing and operating electric light and power apparatus shall hold a license from the New England Electric Exchange, in accordance with its "Plan of Licensing" adopted April 9, 1888.

We would earnestly recommend that all those interested in furnishing safe and reliable illuminants, give their fullest co-operation to the efforts of the New England Electric Exchange.

ARTHUR A. CLARKE,
S. E. BARTON, *Secretary.*
Chairman Electric Light Committee
New England Insurance Exchange.

*** The American Electrical Works, Providence, very considerately sent a cannon cracker to a host of its friends to be fired at 1.30 A. M., July 4th, stating that "as one million will be fired, be prompt that the effect may be as grand as possible."

*** Telephone communication was broken off with all points from Ansonia, Conn., beyond Seymour, Monday afternoon, owing to the breaking of half a dozen lines by the falling of a tree alongside the telephone wires. A number of linemen went to work to repair the break the next day.

Telephonic News

*** At a meeting of the Erie Telephone Directors at Lowell last week, Levi Sprague, of Lowell, was elected president, succeeding J. W. Bennett.

*** A correspondent writes from Albuquerque, N. M., that the telephone company, that for a time suspended operations, has now gone to work again and is giving telephone service.

*** A number of the telephone subscribers of New York and Brooklyn were recipients of the early Chicago convention news through the courtesy of the long distance telephone people, who received the news from Boston from the *Globe* office of that city. The *Globe* had a special wire from its office to the convention hall, and the news was often distributed in New York ahead of the newspaper bulletins.

*** The Supreme Court of Missouri has declined to take up the telephone case from St. Louis until the October term of court. It was confidently expected by city and company that the Supreme Court would take cognizance of the importance of the case and give it a prompt consideration, and both sides undoubtedly feel dissapointed over the delay. None of the telephones removed from the City Hall have as yet been restored, and, as Comptroller Campbell says the city will not sign supplementary contracts, it is hardly probable that they will. It is said that the officers of the company do not expect that the city will make application for the return of the boxes until the test case is decided.

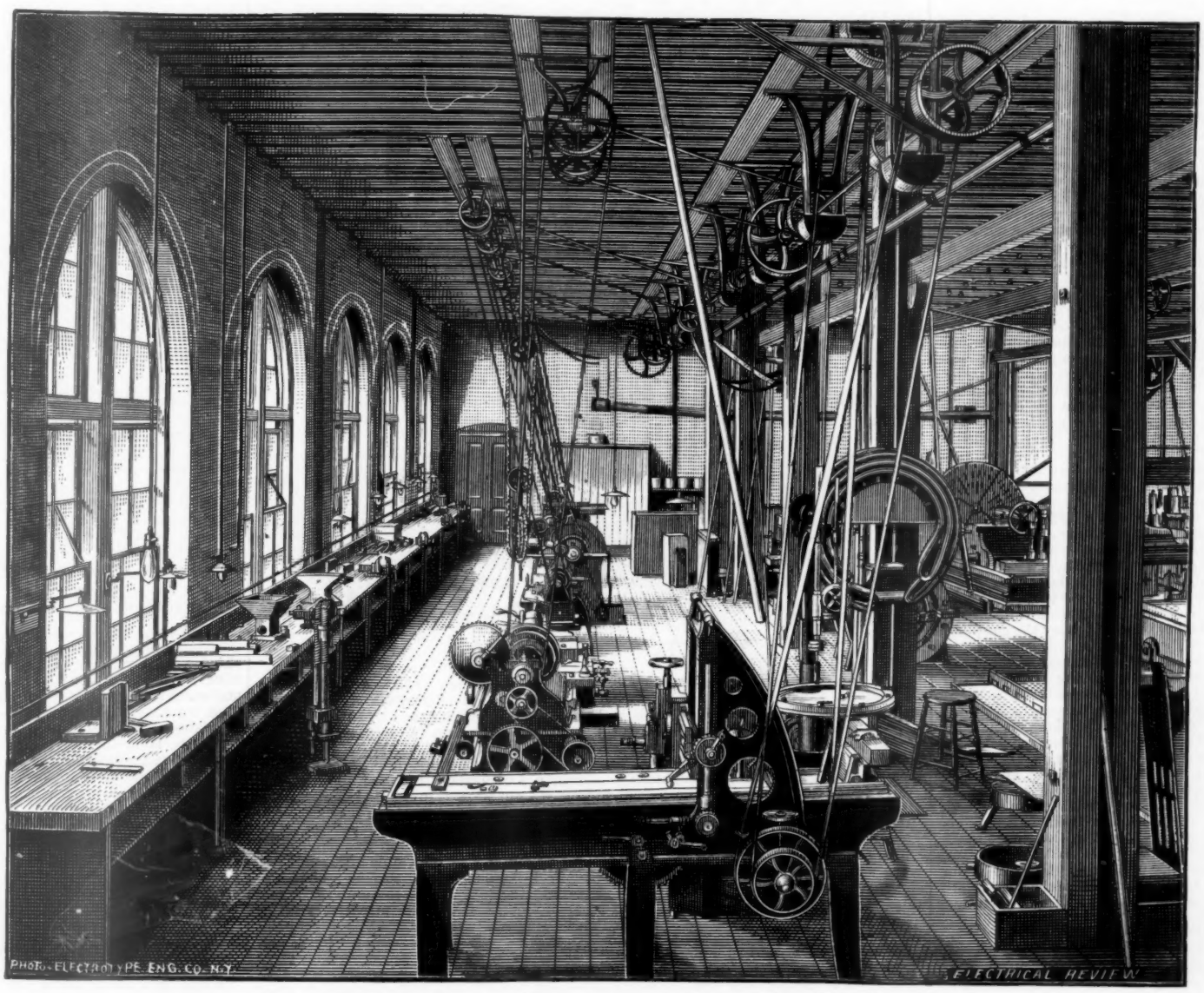


FIG. 4.—THE LABORATORY OF THOMAS A. EDISON.—MACHINE SHOP, FIRST FLOOR.

The Aerial Wire Problem.

(*Continued from page 3.*)

"trunk lines" in the principal directions of demand, with fewer lines in well-known directions. Those are matters which will remedy themselves in the actual conduct of the business, without any legislation or city ordinances. It is certainly wise to consider whether the introduction of wires underground will not bring in other dangers and difficulties that exist now to a small degree, or are practically unknown. The question of induction, particularly in regard to telephone wires, has been alluded to by the speaker; with electric light wires there will be the danger inherent from the greater number of grounds. Assuming that you put in subways in our cities for the main wires, there would still be difficulties where the diversions are made from the subways to the several consumers, and especially at the point where the wires would leave the ground to enter buildings. It seems to me that in the present state of the art, the way to best secure safety to property and life, and to satisfactory service, is rather to put the wires higher up than lower down.

Mr. Madden: I trust this discussion will be made as general as possible, and the gentlemen will not wait to be called on. I shall presume upon the privilege of the Chair to ask Mr. S. S. Wheeler, who is connected with the Board of Electrical Control, to say a few words.

Mr. Wheeler: I am very glad to hear Prof. Anthony defend the overhead wires, because I think they have been blamed more than they ought to be. The talk against them would indicate that their specific dangerousness is a great deal worse than it really is. The paper does not touch upon the question of how to bury the wires, but it seems to me that as long as manufacturers of wires to go underground stand ready to make wires and guarantee them to perform any required work and last any required length of time, within reasonable limits, they should be allowed to furnish those wires and let them be put underground and try them. Companies say, "If you want cable to stand 2,000 volts and last two years, we will guarantee one which we make." If they can do that and guarantee it, it seems to me that embodies the answer to these difficulties. Mr. Woodbury has just alluded to the fact that putting the wires underground was more difficult than putting other conductors underground, because there are additional dangers brought out; for example, in putting gas pipes underground, if the gas leaks, it does no harm except the loss of the gas, whereas a leak of electricity would injure the work of the wire. That is not strictly true. Of course, it makes no difference to the gas companies where there is a small amount of gas lost, and they can afford to go on and let the pipes leak, but there are other people who will suffer. The soil becomes saturated with gas and the city extremely unhealthy. A great deal of sickness is due to this, and if it made it impossible to put the pipes underground there would be the same discussion about whether we could bury the gas pipes. The gas will go into and fill any space left over the pipes, as the manholes of the steam-heating companies and the electrical subways. It becomes so dense that it is impossible to go into these manholes or subways without blowing fresh air into them, and a light will set fire to it. Four or five years ago some gas in a manhole of the Edison Company was set on fire by an electric spark, and it blew the lid off the box, and when the lid came down it struck on the roof of a building in Maiden Lane. The gas blew it there, but it was not an obstacle to putting the gas pipes underground. As to the difficulty of putting the wires underground, I think that should be left to any business corporations which will guarantee the work.

Mr. De Camp: When I started in the electric light business over seven years ago, one of the first things that we encountered was an underground system of conducting wires. At that time the promoters of that enterprise boldly said that the electric light companies, by reason of the danger, if nothing else, should be compelled to put their wires in that particular conduit; that it was cheaper to do it in the first place, and cheaper to maintain them after it had been done. After a few experiments in that direction the question became "only a question of cost." I think that a foolish argument to be used in favor of anything. It is just as consistent to say that the Atlantic can be bridged—it is only a question of cost. I know of no one who has ever attempted to make an estimate of the cost of putting down and maintaining a general system of electric light wires, such as would be necessary to any or all of your larger companies here in the city of New York. I do not see that there is any possible guarantee to be made. There is a guarantee on the first cost to be sure. If a dynamo fails to come up to its guarantee, we simply fall back on what we have already, and only lose the trifle that the experiment has cost, and it does not affect our outside business, but any failure in the guarantee of an underground system would mean serious interruption to our whole outside business.

The Chairman called upon Mr. H. L. Storke, president of the Empire State Telephone Company, who spoke as follows:

I think it is true, as the Chairman just remarked, that the telephone people are responsible for a great deal of the agitation about overhead wires. Until the advent of the telephone, the number of wires required for all electrical purposes was comparatively small. I remember the first agitation on underground wires at Albany, and when such distinguished electricians as Senator Daly and Congressman Tim Campbell [laughter] were at Albany and representatives of the manufacturers of underground cables, all actively engaged in creating public sentiment against the overhead wires. This has resulted, in my judgment, in the premature legislation on that subject before the business had reached the point where it is commercially practicable to make so great and so radical a change in the business, involving such great expense, changing the entire plant and increasing the cost of the service, whether it would improve the quality of the service or not. The whole subject, to those of us who look at it from a business rather than a scientific point of view, is involved in a great many difficulties. I would like to hear from Doctor Baker on this interesting subject.

Mr. Cyrus O. Baker, Jr.: I do not know that I know very much about overhead wires, but if Prof. Anthony had devoted some of his time and energy to whether the company should use platinum wire, I think he would have done a great deal of good to humanity. (Laughter.) I have gained some knowledge about insulated wires since I sat here, as I have been sitting alongside of a manufacturer of insulated wire who tells me that all that is necessary is to whitewash the wire and then sell it at a high price. (Laughter.)

Mr. A. O. Tate: I would like to call on Mr. Tesla.

Mr. Nikola Tesla: I feel like the man who wanted to commit suicide, but did not know which to choose out of four or five different ways. I take a great deal of interest in this subject from the scientific point of view. I think that about two years ago Sir William Thomson expressed himself on the underground question that there was no difficulty in putting the wires underground, electrically speaking, not considering the practical difficulties. The danger will undoubtedly not be diminished by putting them underground, but I think it will be increased. One element which would add to the danger is that we will have to carry a greater number of wires together, because the cost would be enormous if we were to carry the wires through all the streets as we now do, and if a fire should occur there would probably be an interruption of greater consequence than at present. I remember reading last year of a number of cases where people fell from the roofs of burning buildings onto the wires and escaped with their lives—ten or twelve cases of that kind—so that actually they have saved more lives than they have destroyed. As regards the obstruction of the overhead wires, I think they should be put up in such a way that they would be as ornamental as any other thing,—as they are put up in Germany and in Paris. In Strasburg we had to put some Edison wires underground in tubes. The tubes were most of them imperfect and soon got out of order, and after the German Railroad had spent a good many dollars in repairs they struck upon the idea of putting these tubes overhead, and they carried this out and painted them nicely so that they were quite ornamental and not in any wise disfiguring.

The wire manufacturers were called upon. Mr. Godfrey of the New York Insulated Wire Company said: "I think it is entirely out of place for any one interested in the manufacture of cables to discuss this question, and for that reason I ask to be excused."

Mr. Candee of the Okonite Company, was called out and said: "I think that is the general opinion of manufacturers, because we are more or less biased in favor of our own goods."

Prof. Marks: One of the great difficulties of conveying a current is the necessity of accessibility and, in case of difficulty, the certainty of electricity. The moment it finds an opportunity to act it acts, and as soon as it gets bad it gets serious. Vanishing grounds are one of the worst things you get. You find a ground, test it out, go there and cut your line, and it is not there and you close it up again, and in a day or two it reappears.

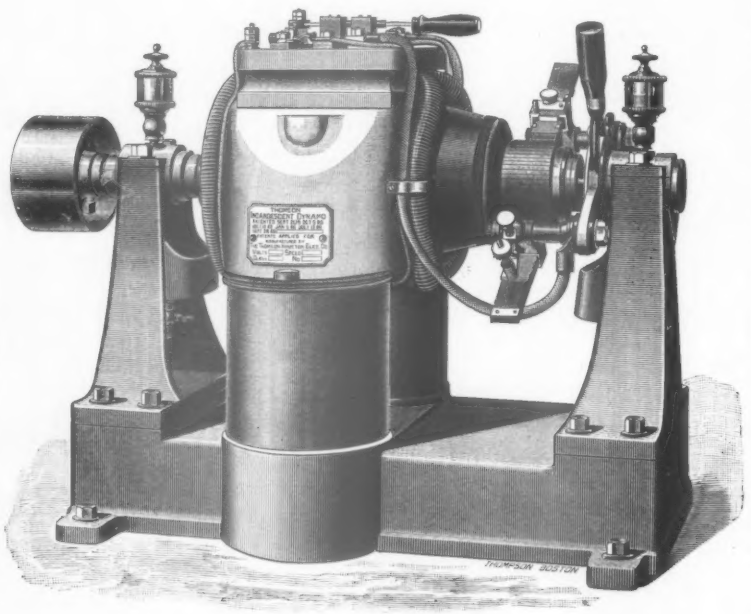
In Philadelphia the Edison Company is going ahead with its underground system, and the Philadelphians are putting their money into it with every confidence of success and believe that it will be money making. It is very expensive to put down, but it can be perfected, and I do not think anybody who has gone into it carefully can doubt that it will be successful.

Lieutenant Toppan: I have tried to listen very attentively to the discussion of the evening, but I would like to have certain points indicated to me, and possibly it would be desired by all hands, as to the principal difficulties which obtain in this placing the wires underground. I have heard from Mr. DeCamp that the difficulties are very much multiplied by placing the wires underground, but there seems to be very little that is specific about it. I do not seem to get a clear idea of what these difficulties are. Of course, I understand that the approachability, if I am allowed to use that word, in the getting at leaks and repairing the lines, etc., is somewhat difficult, but if we can allow that to be eliminated for the moment, I would like to hear something further.

Prof. Anthony: If I may be allowed to occupy the attention of the club for a moment more, I would like to say a word or two in regard to the matter of the difficulty of putting the wires underground. In the first place, the wires must be insulated. There is no better insulator than empty space. We cannot have empty space; space is filled with something around our earth, and there is no better insulator around our earth than dry air. If we put the wires overhead we have to support them on something; if on glass—glass is a pretty fair insulator, not very good, but pretty fair—and the points of support come at considerable distances apart and the chances of leakage are limited. Furthermore, we are not limited as to space. If we put the wires undergroud we must surround them with something besides dry air, and we do not have an extended space to put them in, and if you have 100 or 500 or 1,000 wires to run down your street you must put them pretty close together. The closer you get them together, the greater the leakage. There will be some leak from the wire to the ground when the very best insulator is used, and there will be somewhere a leak from one wire to another if they are in close proximity to each other. The question is, how much leak can you allow? Can you, at any reasonable expense, put these wires underground far enough apart and surround them so completely with insulating material of such character that you will prevent a leak of a degree that is necessary to make a circuit a success. I have never seen a dynamo so insulated that a person standing on a damp ground, himself not insulated, would not receive a considerable shock by coming in contact with the wires, even in a one or two hundred volt circuit. Even where the dynamo is standing on a dry floor and the wires do not go out of the building, if you stand in water you will feel a shock, and you would not unless there were a leak from the dynamo or from the wire. If there is a leak in such a case as that, how will it be when you put the wires underground? No doubt, if you go to expense enough, you can insulate these wires, but the question is, how much is the service worth? Can you furnish the service and charge enough for it to pay for making the insulation in that way?

Mr. C. W. Spear: In this discussion are we not losing sight of some of the particular points in connection with it. In other words, like our friend Flannagan of Texas, "What are we here for?" The point is this: You take an underground circuit of an arc current and when you bring it to the surface to light a lamp there is danger to life. What has been the experience in the city of New York with our high potential currents dangerous to life and property. There has simply been five deaths in seven or eight years, and the recent deaths have been: One in the employ of the company, and in the other case, of a man who very foolishly played with the current. Now, if the wires had been underground, Mr. President, both of those accidents would have occurred the same way. If you wish to prevent all damage to life you must not only put the wires underground, but you must put the lamps underground with them. It has been suggested to reduce the volts to 500. In that case we will not take life, we will simply burn down property (laughter), but, nevertheless, it comes down to a question of comparative cost. Electric lighting in Great Britain and London is nothing, owing to the prohibitory legislation. Now, gentlemen, we are simply in the electric lighting business for the purpose of doing a legitimate business, for selling our goods and getting our price, with a reasonable profit. Just the moment these restrictions prevent us from doing that business, just that moment we will have to shut up shop. Of course, we all know it is possible to put a wire underground, and it is possible to force a current through it and waste a certain amount of energy of a steam engine by induction and leakage. So long as we can do that and get a fair return upon our money invested, just so long we can do business, but when the time comes, as it is in England to-day, that you cannot put out an old shilling and take in a new one, then we will shut up shop.

On motion of Mr. Storke, the meeting adjourned, and the parlors of the club were repaired to, where the members spent the balance of a very enjoyable evening.



New Thomson-Houston Dynamo.

New Thomson-Houston Dynamo.

This new dynamo, illustrated on this page, possesses many valuable features. It is made shunt wound, to supply a demand for a machine for the charging storage battery cells, and series shunt wound, for direct lighting. This machine is perfectly automatic in its regulation, so that any load can be carried from one lamp to the full capacity of the machine, and lamps may be turned on and off without readjustment of the brushes, or giving the dynamo particular attention. Every part is proportioned for durability and simplicity. The commutators and brushes are easy of access. It is compact and occupies small floor space.

It is announced that an electric motor factory is to be started in Waterbury, Conn.

Wethersfield, Conn., is pleased over the prospect of the extension of the electric road from Hartford to that town.

Memphis, Tenn., is negotiating with an electric motor railway company, and is desirous of having the road started the first day possible.

The Sprague Company have just received an order for the equipment of 40 new cars on the old line in Richmond, Va., the same to be completed by the 1st of October. This makes the total Richmond equipment of 80 cars, and about 27 miles of track, and it is expected that the number of cars will be increased to over 100 in the near future. The number of passengers carried daily averages about 12,000.

Hunting For Dead Wires.

The Inspectors sent out by the Board of Electrical Control of New York, make daily reports of dead or unused wires that are strung in the streets. The reports are forwarded to Commissioner Newton, of the Department of Public Works, and by him referred to Superintendent Richardson, but no wires have yet been pulled down. General Newton says that the department will try to find out to whom the wires belong, and have them removed by their owners if possible. If this is not accomplished, they will be taken down at the expense of the city.

To Manufacture Aluminum and Silicon.

A new manufacturing company has been formed under the name of The Aluminum Brass and Bronze Company, with a capital of $250,000, for the manufacture of aluminum and the alloys of silicon. The first meeting of stockholders was held in Waterbury, Conn., Wednesday, June 20. The board of directors elected was: F. J. Kingsbury, Sr., Dr. Leonard Waldo, Charles S. Morse and F. J. Kingsbury, Jr., all of Waterbury, William Powe, Ansonia Wm. E. Curtis, New York, and Samuel B. Hawley, Yonkers, N. Y. Officers, F. J. Kingsbury, Sr., president; William Powe, treasurer, and F. J. Kingsbury, Jr., secretary. Dr. Waldo will be electrical engineer and Charles S. Morse mechanical superintendent. A location has not yet been decided upon, but Bridgeport is talked of as the place for erecting factories. The company is encouraged by the success that the companies abroad have met with. It controls the exclusive rights, under the Cowles patents, of the alloys of aluminum in sheets, rods andwire. The Cowles electric furnace is situated at Lockport, N. Y. Experiments have already been made at the Scovill Manufacturing Company's; from the first the Standard Time Company has used the wire, and says it wants no other. The Sprague Electric Railway and Motor Company are alsousing the silicon bronze wire.

Mr. Powe was general manager and assistant treasurer of the Ansonia Brass and Copper Company. Mr. Morse was for nine years connected with Wallace & Sons, Ansonia, and for six years has been superintendent at Scovill's. The other officers are well-known gentlemen connected with the Scovill Manufacturing Company, of Waterbury.

A Point for Inventors who "Don't P'int Out."

There is a colored congregation of Methodists, says the Kansas City *Star*, who, until a couple of months ago, were led in the paths of rectitude by a very young preacher. He was a fluent son of Ham, and the length of the words he hurled at his hearers was only limited by the amount of oxygen he could take into his lungs at one effort.

This was all very well for a time, but when the elders of the church saw that the arguments adduced did not improve the conduct of the erring ones a change was decided upon, and a committee of one was appointed to ask for the preacher's resignation.

When the errand had been stated, the preacher indignantly asked what the congregation expected for nothing.

"Waal, now, doan' yo' see, we duzzent expect——"

"Isn't my chracter away up yan above procrastinashun?"

"No trouble 'bout dat; but, sah, yer isn't fur enuf eddicated to——"

"Kain't I talk confluently enuf ter suit de most rapashus?"

"Dat's it, chile—dat's it; hole right on whar y'ar, now. Yo' kin talk an' yo' kin talk, but yo' doan't p'int out; yo' kin argyfy and yo' kin argyfy, but yo' doan't show wharein."

The resignation was handed in directly.

—— The Electric Light and Power Company of Burlington, Iowa, is pleased with the information that the incandescent system ordered of the U. S. Electric Lighting Co., New York, has finally been shipped. This latter company has been greatly crowded with orders, which, following so close on the disastrous fire that destroyed the factory, compelled delay. The U. S. Company is now in good shape and is quietly doing a very large business.

The Influence of the Condenser on Disruptive Discharges.

To the Editor of Electrical Review:

While investigating some troubles in an arc light circuit recently, I was led into a series of experiments on the subject forming the title of this communication, and while the method of experimentation was rather crude, the results obtained are, I think, of a value sufficient to warrant my presenting them to the public.

For the experiments a direct current of an E. M. F., suitable for the work was not at hand, so an alternating one was used, connections being made to the street mains of an electric light plant, the E. M. F. on the circuit being 1,000 volts.

A special transformer was used, having five terminals, the primary forming a portion of the secondary circuit.

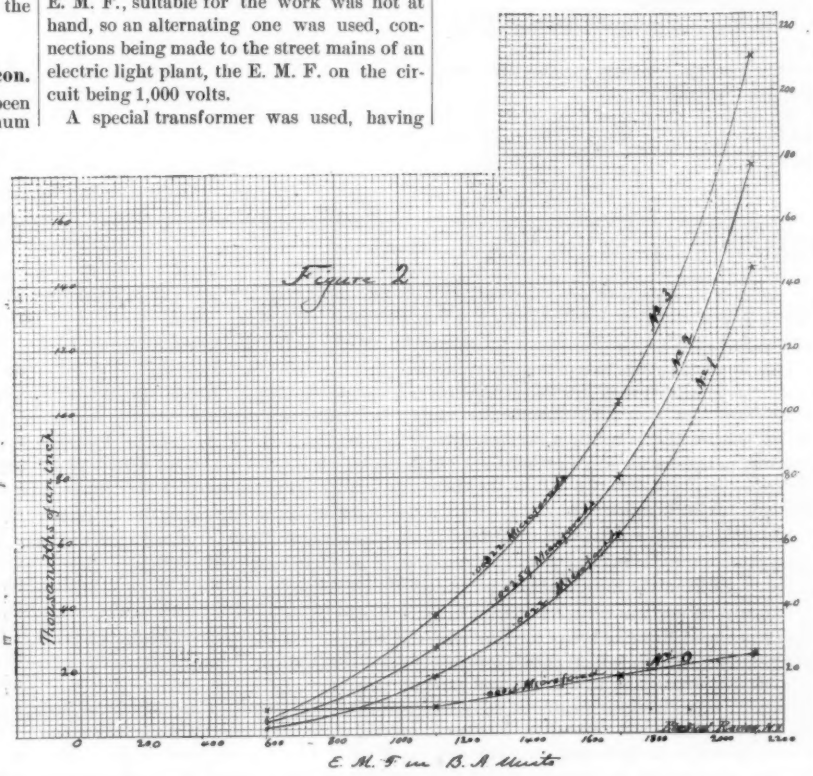
One of the terminals was connected direct to one side of the experimental working circuit, while by means of a switch, either one of the other four could, at will, be connected to the other side of the circuit. By this arrangement four E. M. Fs. could be had, as desired; and for convenience of expression, I will term these different connections, circuits, and number them one, two, three four, in the order of their E. M. Fs.

In order to determine the E. M. Fs. of these circuits, I made a series of fifty measurements of each, using Law's method for direct currents. The condenser was made of a plate of glass with tin-foil on each side, and was found to have a capacity of .00282 microfarads, and answered admirably for the work.

The condenser being placed in the circuit, would upon opening the circuit, by means of a key, hold a charge of a value dependent upon the potential of the terminals of the transformer, at the moment of opening, and by suitable connections this charge could be discharged through a galvanometer, and its exact value determined.

This operation of charging from the transformer and discharging through a 10,000 ohm, mirror galvanometer, was repeated 50 times for each of the four circuits. Of the 50 determinations of the E. M. F. for each circuit, the highest value obtained was assumed to be the true one for its circuit.

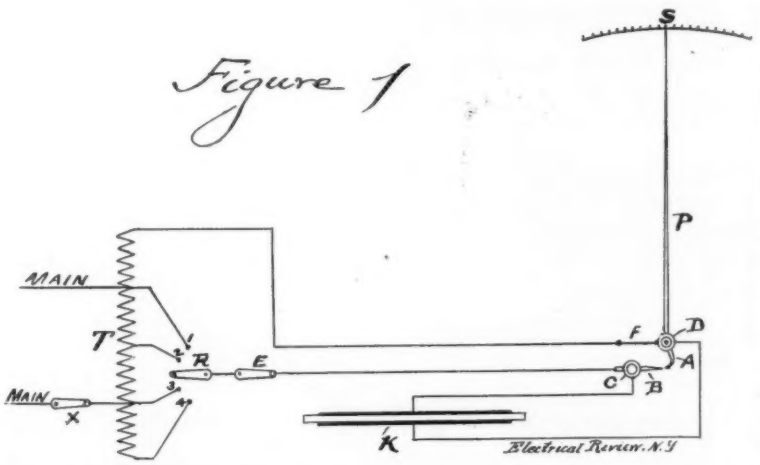
By this method I found the four circuits to have the following E. M. Fs.



Circuit No. 1.....	580 Volts.
" " 2.....	1,110 "
" " 3.....	1,690 "
" " 4.....	2,114 "

The transformer was built for 2,000 volts with 1,000 volts in the primary circuit. My results showed a little over that amount.

Having now the data necessary for plotting the E. M. Fs. of the circuit, work was directed to the measuring of the spark lengths, and the investigation of the influence of the E. M. F. and condenser, on them.



Diagrams Illustrating Mr. E. G. Acheson's Article.—For other cuts see page 10.

Three condensers were made as before described, and carefully measured. The capacities were:

Condenser No. 1..	.0018	Microfarads.
" " 2..	.00219	"
" " 3..	.00282	"

The working circuits without a condenser were found to have a capacity of .0004 microfarads, and when working up the measurements, this capacity was always added to that of the cendenser used.

To measure the spark lengths, an arrangement of apparatus was used, as shown in

(Continued on Page 10.)

ELECTRIC LIGHT NEWS

—— The Edison Company is still fighting for a franchise in the city of Brooklyn.

—— The Trustees of Fresno, Cal., have granted an electric light franchise to A. H. Emery and others.

—— The Berkeley, Cal., Electric Light Company now propose to put lights in every available part of town.

—— Accumulator central stations are now being installed at Cherryfield and Brunswick, Maine. The Faure storage battery is to be used.

—— The new dynamo for the electric railroad in San Jose, Cal., has been in place some time, and it is hoped the road will soon be running.

—— Philadelphia is determined to get the full benefit of the electric and gas lamps, and all obstructing awnings and tree branches are ordered removed.

—— Coronado Beach, Cal., was in darkness for several nights last week, but the necessary repairs having been made, the town is again rejoicing.

—— The electric light company of Honesdale, Pa., are arranging to erect a large station for their plant. The capacity of the incandescent light will then be greatly increased.

—— The Electrical Accumulator Co. have contracted for an installation of accumulators at Cooperstown, N. Y. The plant is to be used in connection with the present Edison system.

—— The Columbia (S. C.) Electric Company has perfected arrangements for the purchase of its plant, and will soon be in active operation. A good business is anticipated.

—— E. J. Baldwin, proprietor of the Baldwin Hotel and Theater, San Francisco, Cal., has made application to the supervisors for permission to erect works and lay pipes to light the hotel and theater by electricity.

—— A proposition looking to the establishment of an electric light plant at Lexington, Mo., although the city enjoys a splendid system of gas works, has been submitted to the Council by Ed. W. Abendrath, proprietor of the Lexington Water Works.

—— The New Bedford, Mass., Gas Company is having put into its electric lighting station on School street, a 100 horse-power Armington & Sims engine, for running its motors and for the extension of the Westinghouse electric lighting system.

—— The Waterhouse Electric and Manufacturing Company, Hartford, Conn., have recently made shipment of two car loads of machinery to the Cincinnati exposition buildings. This company has the contract for lighting the building and grounds.

—— The steam plant which is to be erected by the Ball Engine Company of Erie, Pa., at Union City, Ind., is nearly completed, and it is the purpose of the local company to get everything in readiness so that they can illuminate their city on the 4th of July.

—— The Electrical Accumulator Company have recently closed a contract with the Provincial Railway of Buenos Ayers, S. A., for the lighting of 22 cars by the accumulator system. The dynamos, and other apparatus for the charging stations as well, are furnished by this company.

—— The stockholders of the Middletown (Conn.) Electric Light Company met Thursday evening and elected the following directors: D. W. Northrop, J. P. Stow, H. R. Butler, H. L. Mansfield, Wm. Wilcox, W. H. Burrows and Wm. T. Elmer. The last four named gentlemen are directors in the gas company, and they will no doubt direct the business of the electric light company so that it will not prove a dangerous rival to the gas company.

figure one, in which A and B are two points, mounted in the posts C and D, the latter being made so as to turn upon its centre; P, is a pointer attached to D; S, is a scale; T, is the transformer; R, is a switch for connecting up either one of the four circuits; E, is a switch used for opening and closing the experimental circuit; F, is a fusible wire connection, to protect the transformer; K, is a condenser, and X a switch for opening main line.

The relative distances from D to S and A, were as 15 to 1, and the scale was graduated so that a movement of the pointer one division, moved the point A one one-hundredth of an inch, but owing to the size of the graduation, a movement of one one-thousandth of an inch could readily be detected.

The mode of operation was to first set the points so as to just touch each other, and the reading of the scale noted, after which D was swung upon its centre, sufficient to draw A from B such a distance as to prevent a discharge occurring across the intervening space, upon opening and closing E 50 times. A was then caused to approach B, by steps of one one-thousandth of an inch; 50 ruptures of the circuit being made after each advance.

When a discharge occurred, note was made of the scale reading, and the difference between it and the first reading was a measure of the spark length. The true distance between the points would, of course, be the chord of the arc described by the point A; but the distances were so small that this error was neglected, and the distance measured on the arc. When a condenser was used, it was connected up between the posts C and D, as shown in the figure.

Measurements were made with this apparatus of the spark lengths produced by each circuit, first without a condenser, and then with each of the three condensers, successively connected up to C and D. The results obtained for the various conditions were:

	Spark lengths in inches.			
Circuit.	1	2	3	4
Condenser No. 0	.008	.0085	.018	.025
Condenser No. 1	.002	.018	.062	.145
Condenser No. 2	.004	.027	.080	.177
Condenser No. 3	.005	.037	.103	.211

Figure 2 shows the results obtained, in curves; each curve being numbered the same as the condenser used to produce it; No. 0 being the curve determined without a condenser.

In Fig. 3 I have plotted the curves by laying off the capacity of the circuit horizontally, and as before, representing the length of the spark, by the ordinates.

The four curves represent the four circuits, and are numbered accordingly.

To determine whether the E. M. Fs. were influenced by a discharge from the magnetic field of the transformer, they were remeasured with a condenser having a capacity of .00077 microfarads. If a discharge occurred, the increase of the E. M. F. above the true value would be proportional to the discharge, and the latter would be subject to the amount of current on the circuit; hence, by decreasing the capacity of the condenser, a lower E. M. F. would result.

The E. M. Fs., as measured, were: Circuit No. 1, 625 volts; circuit No. 2, 1176 volts; circuit No. 3, 1580 volts; circuit No. 4, 2058 volts.

The E. M. Fs. of the first and second circuits are higher, and those of the third and fourth are lower than those obtained with the larger condenser, but the differences are not greater than would be expected under the circumstances, and, as will be seen from the curves produced, their relations are such as to leave no ground for assuming a discharge from the field.

I would mention that while the first set of E. M. Fs. were determined when the machinery in the laboratory and surrounding neighborhood was in motion; the second set was measured under the most favorable conditions, the machinery being motionless.

In Fig. 4, I have plotted two curves, A and B; in each of which the ordinates represent the length of the spark, and the abscissa of the E. M. F. in B, A, units.

The experimentally determined spark lengths for each of the four circuits are the same in both curves, and are marked with circles.

Curve A was plotted from the E. M. Fs., as found with condenser No. 3, and curve B from the results obtained from the small condenser, having the capacity .00077 microfarad.

The curve C, in Fig. 4, is very nearly the mean of curves A and B, and was calculated by this formula:

$$\frac{(\text{E. M. F.})^2 \times \text{Charge in Coulombs}}{a} = d.$$

Where a is a constant for the dielectric, and d is the spark length.

The charge being equal to the E. M. F. multiplied by the capacity, the formula may be written:

$$\frac{(\text{E. M. F.})^2 \times \text{Capacity}}{a} = d.$$

In calculating curve C, 135 was taken as the value of a, and d was in inches, the formula then being:

$$\frac{(\text{E. M. F.})^2 \times \text{Capacity}}{135} = \text{inches} = \text{Length of spark in air.}$$

I am now engaged in determining the value of a for a number of dielectrics, especially those used for insulating conductors in cables, and at the same time experimental work is being done on the determination of the part this phenomenon plays in the operating of underground cables.

Pittsburgh, June 30. E. G. ACHESON.

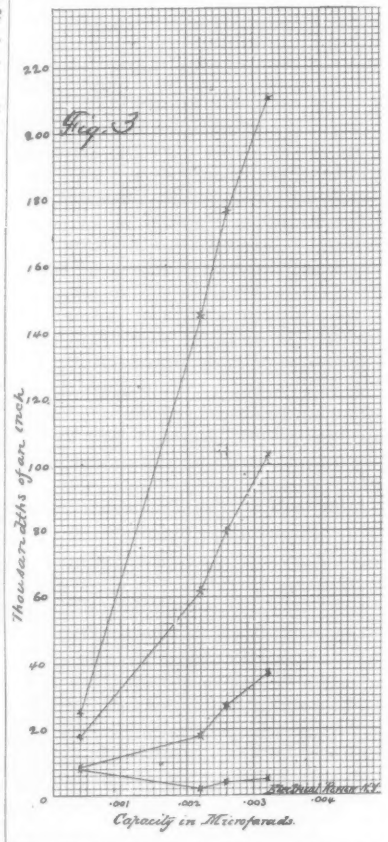
An Electric Bone Cutter.

Removal of sections of bone in surgical operations has heretofore been a long, tedious process, effected with mallet, chisel, gouges, etc. It is, perhaps, the most brutal and unscientific method which could be adopted and sounds like the operative butchery which existed in the last century. This has all been reformed by an invention called the electric osteotome, which is an instrument holding a a circular saw at its extremity, revolved with lightning speed by an electric motor. This, when held against a bone, makes a clean cut through it in a few seconds; in fact, its action is instantaneous. By holding the osteotome in a slanting position, wedge shaped pieces can be cut out with equal promptitude. There is no danger of the saw cutting the soft parts, as they are protected by a retractor, an instrment which is passed down and under the bone.

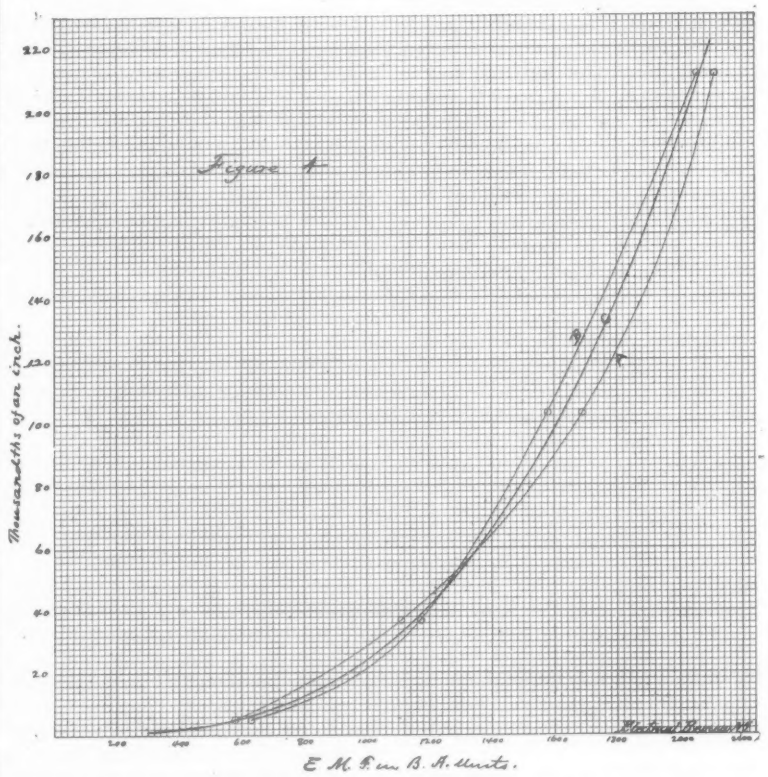
—— The Brush Electric Light Company of Cincinnati, Ohio, are extending their system and are erecting poles on Fifth street.

Manufacturing Notes.

Jarvis B. Edson, 145 Broadway, reports that notwithstanding the various complaints of dullness in business affairs, his orders for Pressure Recording Gauges have lately exceeded his manufacturing capacity, and he has added to his plant and working force.



The National Transit Company have just ordered fifteen additional instruments, making over fifty now in use on their lines, working up to a pressure of fifteen hundred pounds to the square inch. Orders from paper mills and electric light installations continue with gratifying frequency.



The Clark Electric Company, of 159 Chambers street, N. Y., has just issued an attractive little pamphlet setting forth the advantages of the Clark dynamo and lamp, which were illustrated in this journal several months ago. This dynamo was awarded the "Medal of Excellence," at the American Institute, and presents the record of 20 lamps, with $11\frac{9}{10}$ horse power. The company states that all the statements in the pamphlet concerning the excellent work of this system have been proven by actual test and practical operation. A strong claim is made for the steadiness of this arc light, as well as its brilliancy.

Kansas City, Mo.—The Wire Dredge Manufacturing Company. Capital, $20,000. W. T. Urie and others, incorporators.

Jersey City, N. J.—The Fox Electrical Manufacturing Company. Capital, $50,000. Henry E. Fox and others, incorporators.

Omaha, Neb.—The Interstate Fire Alarm Company, Omaha, Neb. Capital, $50,000. F. B. Johnson and others, incorporators.

Richmond, Va.—The Gatling Ordnance Company, Richmond, Va. Capital, $1,000,000. R. G. Gatling and others, incorporators.

Brockport, N. Y.—The Brockport Electric Company has been incorporated. Capital, $15,000. Francis H. Leonard and others, incorporators.

Mount Vernon, N. Y.—The Mount Vernon Electric Company has been incorporated. Capital, $50,000. Edward S. Seers and others, incorporators.

Cincinnati, Ohio.—The Cincinnati and Suburban Electric Railway Company. Capital, $100,000. Charles T. McCrea and others, incorporators.

Portland, Me.—The Gould Tisdale Revolving Semaphone Company, Portland, Me. Capital, $500,000. William T. Eaton and others, incorporators.

Zanesville, Ohio—The Zanesville Edison Electric Light and Power Company has been incorporated. Capital, $60,000. Alexander Grant and others, incorporators.

Waterbury, Conn.—The Aluminum Brass and Bronze Company. Capital stock, $250,000. Directors, F. J. Kingsbury, Sr., Dr. Leonard Waldo, Charles S. Morse and F. J. Kingsbury, Jr., of Waterbury, and others, incorporators.

Chicago, Ill.—The Harrison and Ross Refining Company, of Chicago. Capital stock, $10,000. To refine cast iron and make it soft, strong and of uniform temper. Incorporators, James Harrison, T. W. Ross, A. D. Ross and L. P. Karhardt.

Albany, N. Y.—The capital stock of the Commercial Union Telegraph Company of Albany, has been increased from $200,000 to $300,000. There are a number of changes in the route. The line will include connections with Burlington and Plattsburgh.

Amsterdam, N. Y.—The Amsterdam and Hagaman's Mills Electric Railroad Company of Amsterdam was incorporated. The road will begin on Main street, Amsterdam, and continue north through Rock City to Hagaman's Mills, about four miles. The directors of the new road are Mathias M. Smith, Edward C. Sterling, William C. Jones, James H. Hurst, Albert E. Tabel, Eugene R. Huckel and P. S. Jones.

A New Motor.

Old Lady—"Do you actually mean it, Mr. Sharpley, that the boats from New York to Boston go by Sound?" Sharpley—"Positive fact, madam, no question about it." Old Lady—"Goodness gracious! what a queer motive power. What will they do next? First they had sails, then steam, then electricity, and now it's sound. I just reckon it's one of that man Edison's inventions. No wonder they call him the Wizard; he can do most anything."

Chief Engineer M. Thier, of Erfurt, Germany, says the *Eisen-Zeitung*, after battling for months to find a lubricator which would prevent the welding together of iron surfaces upon which much and rapid friction is exercised, such as turbine wheels, etc., has at last found that ordinary oil of mustard, mixed with small quantities of petroleum, fish oil or other similar fatty substances, answers the purpose in every respect and overcomes all the difficulties heretofore experienced with machinery where excessive friction disturbs the physical quality of the metal used.

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JUNE 26, 1888.

384,958 Galvanic battery; Charles A. Brown and Martin M. Clark, Chicago, Ill., assignors to the Western Electric Company, same place.

384,962 Electric railway signal; Stanley C. C. Currie, London, County of Middlesex, England, assignor to Currie-Timmis Electric and Railway Supply Company.

385,001 Rheostat; James W. Packard, New York, N. Y.

385,020 Electric light system; Bernard E. Sunny, Chicago, Ill.

385,022 Apparatus for electric welding; Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, Boston, Mass.

385,023 Electric switch; Patrick J. Tracy, Racine, Wis.

385,028 Electrolyte for galvanic batteries; Bloomfield J. Wheelock, New York, N. Y.

385,034 Electro-motive railway; Granville T. Woods, Cincinnati, Ohio, assignor to the Woods Electric Company, same place.

385,039 Holder for incandescent lamps.

385,041 Switch for electrical purposes; William A. Carey, Malden, Mass.

385,042 Mariners' recording compass.

385,043 Electric alarm compass; Henry A. Chase, Stoneham, Mass.

385,053 Electric railway; Rudoph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place.

385,054 and 385,055 Electric railway; Rudolph M. Hunter, Philadelphia, Pa.

385,067 Electric cut out; Charles G. Perkins, Hartford, Conn.

385,068 Dynamo electric machinery; Anthony Reckinzaur, London, England, assignor to the Electric Car Company of America, Philadelphia, Pa.

385,095 Lightning escape for wire fences; Allin Cockrell, Lamar, Mo.

385,097 Electric railway; G. Herbert Condict, Philadelphia, Pa., assignor to the Electric Car Company of America, of Pennsylvania.

385,145 Method of generating electricity and purifying water; John E. Siebel, Chicago, Ill.

385,147 Galvanic battery; E. Eugene Starr, Philadelphia, Pa., assignor to the S. S. White Dental Manufacturing Company, same place.

385,173 System of electrical distribution; Thomas A. Edison, Llewellyn Park, N. J.

385,180 Electric railway; Rudolph M. Hunter, Philadelphia, Pa.

385,200 Secondary battery; Anthony Reckenzaun, London, England, assignor to the Electric Car Company of America, Philadelphia, Pa.

385,205 Test system for multiple switchboards; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

385,211 Electrical pumping apparatus; Frank J. Sprague, New York, N. Y.

385,214 Telegraph relay. 385,215 Electrical connector; Frederick Stitzel and Charles Weinedel, Louisville, Ky., assignors to the American Semaphore Company, same place.

385,254 Battery zinc; John Doyle, Hoboken, N. J., assignor to himself and C. Coles Dusenbury, Lake Mahopac, N. Y.

385,259 Steering apparatus for vessels; Bradley A. Fiske, U. S. Navy.

385,308 Electric battery. 385,309 Process of amalgamating zinc; Ernest M. Hewitt, Newton, assignor to Daniel W. Crosby, trustee, Boston, Mass.

REISSUES.

10,940 Electro magnetic dental hammer and plugger; Philip Helmer, Clinton, Iowa.

THE DYNAMO.

How it is Made,
— AND —
How to Use It.

A Complete Description of the Various Parts of the Machine, and How to take care of it, with other valuable Electrical Information for the use of those

HAVING CHARGE OF ELECTRIC LIGHTING APPARATUS.

FULLY ILLUSTRATED
WITH MANY NEW PLATES AND CUTS.

Sent Postpaid on Receipt of Postal Note, Money or Express Order for

FIFTY CENTS.

FRED M. KIMBALL & CO.,
BOSTON, MASS.

Proposals Wanted
FOR
Electric Light Plant
AT
SULLIVAN HARBOR, MAINE.

The system wanted must embrace both Arc and Incandescent Lamps, capable of supplying at least 50 arcs and 250 incandescents. 30 of the arcs to be located in the village of Sullivan Harbor, 10 in Sorrento, 3 miles distant; and 10 at Mt. Desert Ferry, 2 miles distant, (overland.) There is enormous water-power on the spot, and it is entirely feasible to utilize it by means of water wheels and storage batteries.

For particulars address

SULLIVAN HARBOR LAND CO.,
95 Milk St., Boston.

J. E. JEFFORDS & CO.,
Manufacturers to the Trade.
POROUS CELLS
Of Every Description, Made to Order.
25 years' experience in this branch of the business.
2716 to 2738 Salmon St., Philadelphia, Pa.

O. K.

Full Size!!!
NO ONE
Denies this to be the only safe automatic in the
LAND
Perfected
Improvements
Commend it to the Trade.
$6.00 EACH.
Discount (—).
A. L. BOGART,
22 Union Sq., N. Y.

WHY everybody interested in Electric Lighting should read "MUNICIPAL LIGHTING." A book of 250 pages, profusely illustrated.

Because it gives all desirable information about the subject of furnishing light.

It tells what systems are used; how they are operated; how the lamps and wires are strung; the area lighted; what the lights cost; the hours burned; the contracts, etc., in nearly every town and city in the country.

It tells all about municipalities that operate their own plants.

It tells how city officials, councils, mayors and others should investigate the subject.

It tells electrical manufacturing companies when public contracts expire.

It tells electricians and others what the underground wire question has developed.

In fact, it gives the alpha and the omega of the whole range of public lighting.

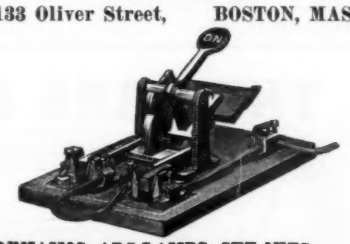
It Should be in the Hands of Everybody.

Councils that are discussing this question; mayors who want to write about it; city clerks who are instructed to procure information on it; newspapers who want to keep posted; electrical people who want to reach the patrons of electrical material; local light companies who want to know what their contemporaries are doing, should all read this book.

Send $1.00 for a copy to
FRED. H. WHIPPLE, Detroit, Mich.
Copies bound in Russia, $1.50.

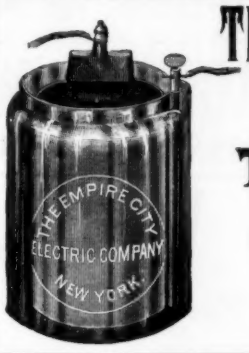
William Marshall,
Manufacturer of Electrical Condensers.
STANDARDS A SPECIALTY.
Rooms 2 and 4 University Building.
Corner Waverley and University Places, New York.

W. S. HILL,
133 Oliver Street, BOSTON, MASS.



DYNAMOS, ARC LAMPS, CUT-OUTS,
DOUBLE POLE SWITCHES,
KEY SOCKETS AND LAMPS.

Detroit Electrical Works
MANUFACTURERS OF
ELECTRIC SUPPLIES,
INCLUDING
Medical Batteries, Skeleton and Box Bells, Burglar Alarms, House Annunciators, Fire Alarm Boxes, Pins and Brackets.
Insulated Magnet, Telephone and Electric Light Wire.
GENERAL OFFICES and FACTORY:
DETROIT, MICH.



THE EMPIRE CITY ELECTRIC CO.
15 Dey Street, New York,
MANUFACTURERS OF
Telephone, Telegraph
— AND —
ELECTRIC LIGHT SUPPLIES.
WRITE FOR PRICES.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWYER, SEC'Y AND ELECTRICIAN.

American Electrical Works

PROVIDENCE, R. I.
MANUFACTURERS OF PATENT FINISHED
INSULATED ELECTRIC WIRES,
TELEPHONE & INCANDESCENT CORDS.
Electric Light Wire
Magnet Wire, Patent Rubber-Covered Wire, Lead-Encased Wire, Flexible Cordage, Office and Annunciator Wire.
Underground and Aeriel Cables.
New York Office: 18 Cortlandt St.
P. C. ACKERMAN, Agent.

E. P. Gleason Manuf'g Co.
181-189 MERCER STREET, NEW YORK.
MANUFACTURERS OF
ELECTRIC LIGHT APPLIANCES, FITTINGS, INSULATED JOINTS, FIXTURES,
Globes, Shades, Fancy Lamps, &c., &c., &c.
SEND FOR CATALOGUE E. AND SUPPLEMENT.

THE CLEVERLY ELECTRICAL WORKS,
1018 CHESTNUT STREET, PHILADELPHIA.
ELECTRICAL SUPPLY MAKERS.

"MUNICIPAL LIGHTING,"
By FRED. H. WHIPPLE.

A new and illustrated book that treats exhaustively of public lighting, with carefully compiled facts from two hundred cities of the United States.
This is a valuable book for everybody interested in electric lighting.
The underground question is presented and experiences given.

"SHOULD CITIES DO THEIR OWN LIGHTING?"

PRICE, $1.00 EACH.

Send in your orders to
ELECTRICAL REVIEW,
13 PARK ROW, NEW YORK.

RICHMOND ROAD.

SPRAGUE SYSTEM.

TOTAL TRACKAGE, 12 MILES. MAXIMUM GRADE, 10⅛ PER CENT.

Twenty-nine curves, such as a 27 foot radius with 5 per cent. grade, 40 foot radius with 8½ per cent. grade, etc. Total Equipment, 40 Cars. Full size, 16 foot closed, and 22 foot open cars. Thirty Cars Now in Operation.

COST OF OPERATING 60 PER CENT. LESS THAN WITH HORSES.

The present mileage of 1,500 to 1,800 miles on these grades would require not less than 225 to 250 horses.

The entire operating expenses chargeable at the Central Station for thirty cars, with the present mileage, on the heaviest section of the track, is 1½ per cent. per car mile. This includes electrician, engineers, firemen, dynamo men, all coal, oil, waste, water, lighting and depreciation; the working force being, with the exception of one man, sufficient to handle forty cars. When the forty cars are in operation the expense will be reduced to about 1¼ cents per car mile run.

Number of Miles Run, 136,214. Passengers carried, 598,613. Schedule Running Time, 7½ miles per hour.

TOTAL OPERATING EXPENSES, INCLUDING EVERYTHING, FOR THE MONTH OF MAY WAS ONLY **47** PER CENT. OF THE RECEIPTS.

SEND FOR MAP AND DETAILS OF THIS ROAD.

SPRAGUE ELECTRIC RAILWAY AND MOTOR COMPANY,

16 & 18 BROAD STREET, NEW YORK.

EDISON MACHINE WORKS,

Schenectady, N. Y.

MANUFACTURERS OF

INSULATED WIRES, FLEXIBLE CORDS AND CABLES,

—FOR—

Telephone, Telegraph AND Electric Light.

JAMES F. KELLY.

GENERAL SALES AGENT,

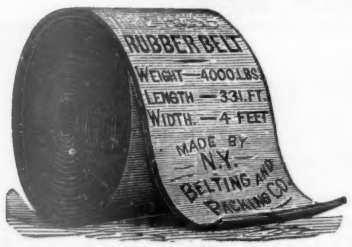
19 Dey Street, New York.

NEW YORK BELTING AND PACKING CO.

WAREHOUSE: 15 PARK ROW, NEW YORK.

The Oldest and Largest Manufacturers in the United States of

VULCANIZED RUBBER



In every form adapted to mechanical purposes.

MACHINE BELTING,

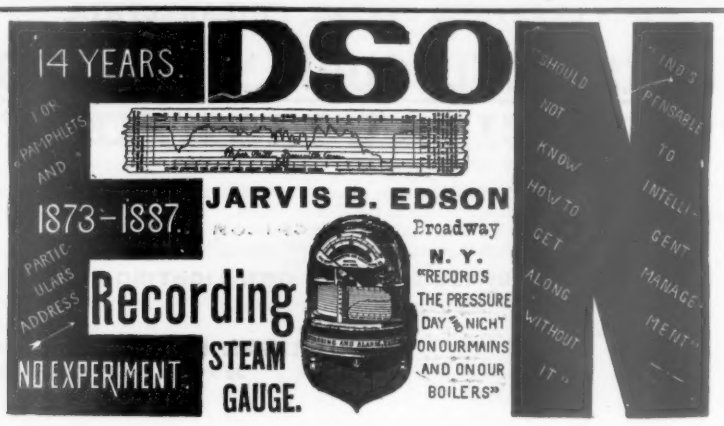
With Smooth Metallic Rubber Surface

This Company has Manufactured the Largest Belts made in the World for the principal elevators at Chicago, Buffalo and New York.

We make a Superior Quality of Belting for Electric Light purposes, for use on Dynamos and Swift running machinery.

JOHN H. CHEEVER, Treasurer.

European Branch: Pickhuben 5, HAMBURG, (Freihafengebiet), GERMANY.



SCHAEFER ELECTRIC MFG. CO.

INCANDESCENT LAMPS, From 10 to 100 Candle Power.
DYNAMO MACHINES of Improved Construction.

Proposals and Estimates furnished for Complete Installations of Incandescent plants upon application to

P. O. BOX 3068, Boston, Mass.

FACTORY AT CAMBRIDGEPORT, MASS.

The SHAW & GEARY

NORWAY IRON FRAME BELLS

HAVE NO EQUAL FOR BEAUTY OF FINISH, DURABILITY AND CHEAPNESS.

SHAW & GEARY,

58 & 55 North Seventh St., Philadelphia.

D. W. Baker. Cyrus O. Baker, Jr.

BAKER & CO.,

Importers, Melters and Refiners of

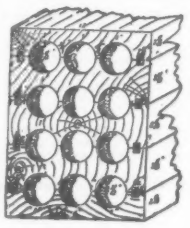
PLATINUM,

408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.

Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased

---

The MacDonald Subway Electrical Conduit.



PATENTED JULY 6, 1886, No. 334,843.

This Conduit is made of Creosoted Timber in 16 feet Lengths.

It is simple, **durable, easily laid, water tight,** and not **expensive.** Conduits from one-half inch to three inches.

Circulars and information furnished.

GEORGE S. VALENTINE,

(Manager Eppinger & Russell Creosoting Works,)

SOLE AGENT,

OFFICE, - - - 160 WATER STREET, N. Y.

Russell & Co.

MASSILLON, OHIO,

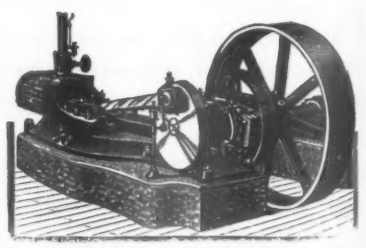
BUILDERS OF

AUTOMATIC ENGINES

BOILERS, ETC.

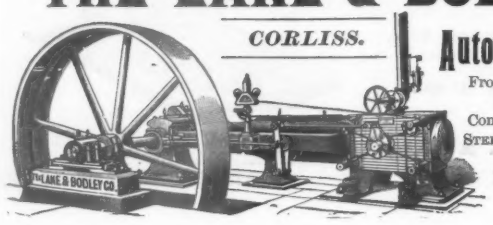
Complete Power Plants Furnished and Erected.

SEND FOR CATALOGUE.



THE LANE & BODLEY CO.

CORLISS.



MANUFACTURERS OF

Automatic Cut off Engines,

From heavy patterns, and unequaled for ELECTRIC LIGHTING, Combining Economy and Reliability.

STEEL BOILERS, HEATERS, SHAFTING, PULLEYS AND GEARING.

THE LANE & BODLEY CO., 265 to 273 Water St., Cincinnati, O.